LAPTOP GAMING SHOOTOUT

INTEGRATED GRAPHICS COMPARED

apc

#541
JAN 2025

YOUR EXPERT GUIDE TO TODAY'S TECH

SINCE 1980

New Apple M4 is here!

Apple MacBook Pro & Apple iMac, PLUS Apple iPad mini

SET AN UPDATE SCHEDULE
INSTALL 'SILENTLY' & QUICKLY
INSTALL THOUSANDS OF TOOLS
CREATE YOUR OWN UPDATER
TURN ON AUTOMATIC UPDATES
UPDATE SOFTWARE IN ONE CLICK
75%

PAGE 36

Lenovo Yoga 7i Aura

Slim, smart, stylish & stunning!

Clean Windows

How to remove bloatware

BYPASS *ALL* INTERNET TRACKING & CENSORSHIP

How to use Tor for complete online freedom

HOW TO

ALWAYS RUN THE LATEST & SAFEST DRIVERS & APPS

- Scan for outdated apps
- Download without any junk
- Get alerts for new programs

01
FUTURE
AUS $11.95 INC GST
NZ $13.90 INC GST
PRINT POST APPROVED: 100000179
ISSN: 0725-4415

IMAGE EDITING

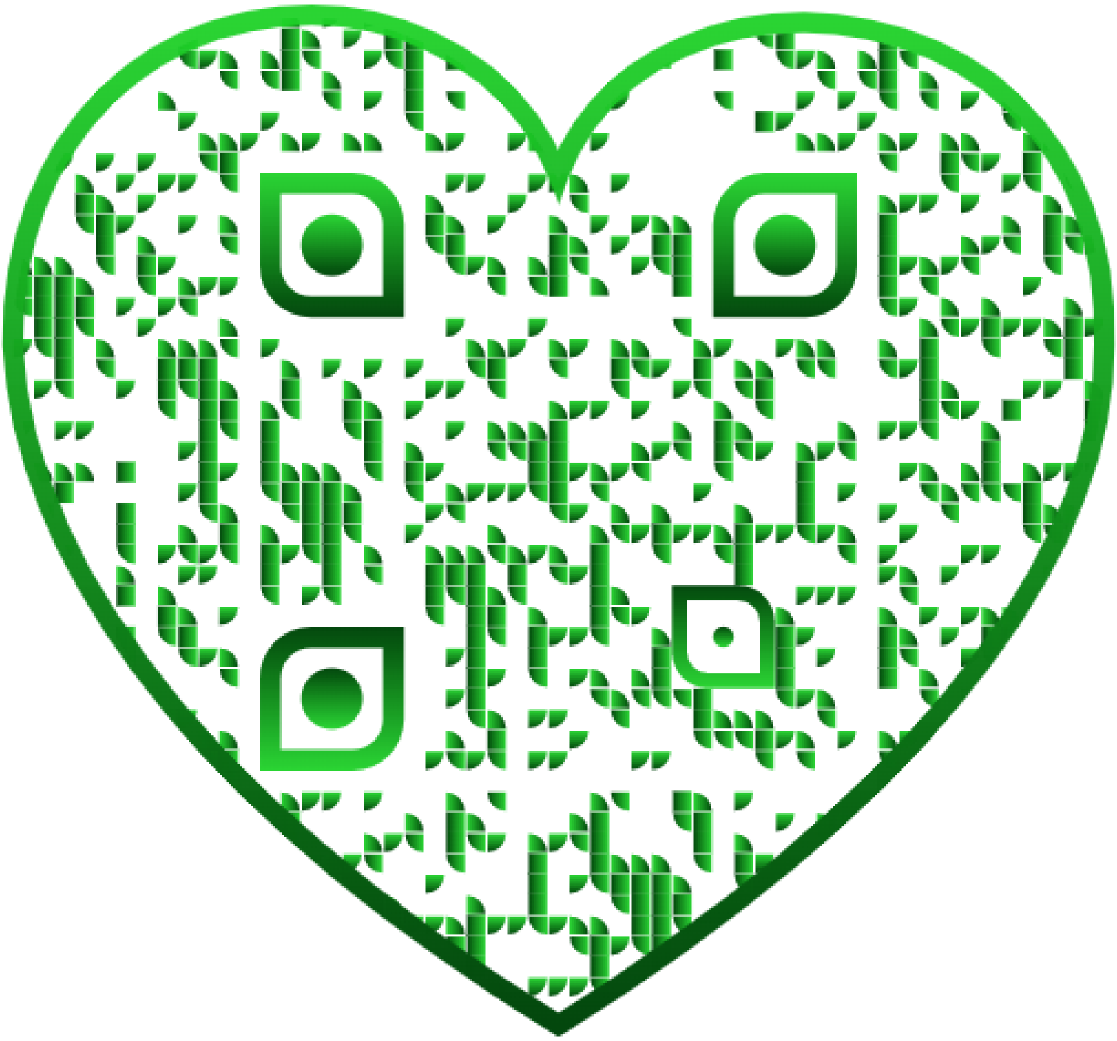
HOW TO USE PHOTOPEA

THE FREE BROWSER-BASED PHOTOSHOP ALTERNATIVE

GOD-KING CPU

RYZEN 9800X3D

"THE SUPERSTAR CHIP OF A GENERATION"



Vigor2865L-5G Series

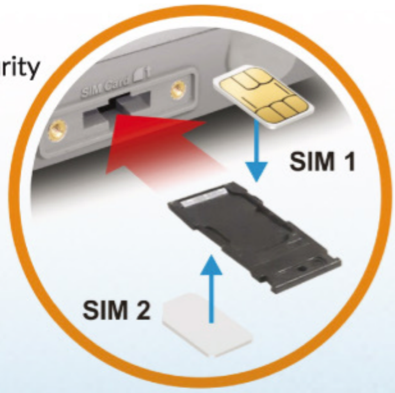
5G/4G LTE and VDSL2 / Ethernet Security Firewall Routers with excellent mobile coverage in AU and NZ

DrayTek
Aust & NZ
www.draytek.com.au

Multi-WAN routers with a dual 5G Nano SIM card slot, 1 x VDSL2 35b modem, 1 x configurable GbE WAN/LAN port, 5 x GbE LAN ports, SPI Firewall, 802.11ax Wi-Fi (Lax-5G model), and 32 x VPN tunnels including 16 x Open-VPN/SSL VPN tunnels

Aust / NZ
VDSL
NBN Ready
Ethernet WAN
NBN Ready
Ethernet WAN
UFB Ready
32 x
VPN
DUAL SIM
Vigor2865Lax-5G
(WiFi 6, AX3000)

- 5G/4G LTE modem with dual nano SIM slots (SIM slot 2 for Failover) for SA and NSA 5G WAN
- Support 5G NR Sub-6 SA Band: n1, 3, 5, 7, 8, 20, 28, 38, 40, 77, 78; great coverage in Australia and New Zealand
- 5G Max. Data Rate NR SA: 2.4Gbps (DL) / 900Mbps (UL)**
- 5G Max. Data Rate NR NSA: 3.4Gbps (DL) / 550Mbps (UL)
- Multi-WAN with 1 x VDSL2 35b modem, 1 x configurable GbE WAN/LAN port, 1 x USB port, 2 x 5G/4G LTE nano SIM slots, and 2 x Wi-Fi WANs for Lax-5G model
- 1 x xDSL port and 1 x configurable GbE WAN/LAN port for Failover, Load Balancing and High Availability mode
- 1 x USB 2.0 port for connection of 3G/4G LTE USB modem, FTP server, network printer and thermometer
- 5 x Gigabit LAN ports with multiple subnets and 60,000 NAT sessions
- 32 x VPN tunnels (including 16 x OpenVPN/ SSL-VPN tunnels) with comprehensive secure protocols
- Fast VPN throughput, VPN Load Balancing and backup for site-to-site applications
- Hardware Acceleration and Hardware QoS for up to 8k NAT and routing connections, and 940Mbps (Single WAN) or 1.3 Gbps (Multi-WAN) Firewall speed
- Integrated IEEE 802.11ax (WiFi 6, AX3000) wireless Access Point; dual band; up to 2402 Mbps throughput (Lax-5G model)
- 16 x VLANs for secure and efficient workgroup management
- IPv6 & IPv4, up to 1022 IP addresses and 8 IP subnets
- Object-based SPI Firewall and CSM (Content Security Management) for network security
- Supports VigorACS 3 Central Management Software for remote management
- SD-WAN capability when used with VigorACS 3
- Central VPN Management for up to 8 remote Vigor routers
- Central AP Management for up to 20 Vigor Access Points
- Central Switch Management for up to 10 VigorSwitches
- 2 years back to base warranty



**Typical 5G Downlink/Uplink speeds are 400Mbps/200Mbps, depending on the local conditions.

i-LAN Technology
i-LAN Technology Pty Ltd trading as DrayTek Aust & NZ
www.draytek.com.au (02) 9838 8899 sales@i-lan.com.au
© Copyright 2024 i-LAN Technology Pty Ltd. All rights reserved.

LAPTOP GAMING SHOOTOUT
apc
ALWAYS LATEST & DRIVERS

SUBSCRIPTION ENQUIRIES

(02) 8227 6486
www.techmags.com.au
future@crmaus.com.au

Editorial
Editor: **Ben Mansill** ben.mansill@futurenet.com
Senior Journalist: **Shaun Prescott**
Senior Journalist: **Lindsay Handmer**
Group Art Director: **Troy Coleman**

Contributors
Jonathan Bolding, Tyler Colp, David Crookes, Nate Drake, Robert Irvine, Zachariah Kelly, Stephen Lambrechts, Rick Lane, Ted Litchfield, Tony Polanco, Les Pounder, Shashank Sharma, Nova Smith, Mark Spoonauer, Tom Sykes, Nik Rawlinson, Jarred Walton, Alex Wawro, Mark Williams

Photography
All copyrights and trademarks are recognised and respected

Advertising
auadvertising@futurenet.com

Management
Managing Director: **Neville Daniels**
Commercial Director: **Chris Ferguson**
chris.ferguson@futurenet.com

Printed in Australia by IVE

Distributed in Australia and NZ by Are Direct

ISSN 0725-4415

Future Publishing Australia
PO Box Q1179, Queen Victoria Building, NSW 1230
Corporate Web: **www.futureplc.com**
Email: **apcmag@futurenet.com**
Web: **www.apcmag.com**

We are committed to only using magazine paper which is derived from responsibly managed, certified forestry and chlorine-free manufacture. The paper in this magazine was sourced and produced from sustainable managed forests, conforming to strict environmental and socioeconomic standards. The manufacturing paper mill holds full FSC (Forest Stewardship Council) or PEFC certification and accreditation

All contents ©2024 Future Publishing Australia or published under licence. All rights reserved. No part of this magazine may be used, stored, transmitted or reproduced in any way without the prior written permission of the publisher. Future Publishing Limited (company number 2008885) is registered in England and Wales. Registered office: Quay House, The Ambury, Bath BA1 1UA. All information contained in this publication is for information only and is, as far as we are aware, correct at the time of going to press. Future cannot accept any responsibility for errors or inaccuracies in such information. You are advised to contact manufacturers and retailers directly with regard to the price of products/services referred to in this publication. Apps and websites mentioned in this publication are not under our control. We are not responsible for their contents or any other changes or updates to them. This magazine is fully independent and not affiliated in any way with the companies mentioned herein.

If you submit material to us, you warrant that you own the material and/or have the necessary rights/permissions to supply the material and you automatically grant Future and its licensees a licence to publish your submission in whole or in part in any/all issues and/or editions of publications, in any format published worldwide and on associated websites, social media channels and associated products. Any material you submit is sent at your own risk and, although every care is taken, neither Future nor its employees, agents, subcontractors or licensees shall be liable for loss or damage. We assume all unsolicited material is for publication unless otherwise stated, and reserve the right to edit, amend, adapt all submissions.

Privacy statement
If you provide information about yourself this will be used to provide you with products or services you have requested. We may supply your information to contractors to enable us to do this. Future Publishing Australia will also use your information to inform you of other publications, products, services and events. Future Publishing Australia may also give your information to organisations that are providing special prizes or offers and are clearly associated with the Reader Offer. Unless you tell us not to, Future Publishing Australia may give your information to other organisations that may use it to inform you of other products, services or events. If you would like to gain access to the information Future Publishing Australia holds about you, please contact us.

FUTURE
Connectors.
Creators.
Experience
Makers.

Future plc is a public company quoted on the London Stock Exchange (symbol: FUTR)
www.futureplc.com

Chief executive **Jon Steinberg**
Non-executive chairman **Richard Huntingford**
Chief financial officer **Sharjeel Suleman**
Tel +44 (0)1225 442 244

Fat-free PC

It's clean up time

If you're anything like me (and I keep telling myself I am normal and typical…), then the summer and new year period is one where you combine doing nothing whatsoever, with the things you've been putting off all year and know you really must tackle sooner or later.

Like giving your PC a once over to get it as fit as you will no doubt be personally after the party season! Starting with bloatware (my physical bloatware is another issue…). If you've just bought a new PC – and laptops are especially bad for this – then it's almost certainly going to have stuff installed that is, at best, annoying, and at worst, a system hog. Straight to page 88, for you, then, dear reader. Our completely-unbloated Nate Drake has put together a most satisfying guide for you covering all the unwelcome irritants you may have lurking on your drive, and how to banish them forever. 'Free trial' pop-ups? Gone! Even Microsoft has its own bloatware taking up space and serving no purpose whatsoever. So, let's get rid of it. Easy.

Now take some time off and celebrate your wins. Then come on back, we're not done yet. Now that we've purged the garbage, it's time to get all your programs and drivers up to date for a maximum-health PC. Over on page 60 there's a pretty fantastic guide for making sure everything is up to date and running the latest and safest versions. There's a bit of tinkering involved, but we're also not averse to do-it-all programs that can give your system new life in one clean sweep, so we've got recommendations for that, plus how to get it done without risk.

Now you can kick back and relax into our reviews and features that require nothing apart from sitting back and enjoying the words. I personally really enjoyed our History of Ray Tracing and Race for Advanced Encryption articles. Both are technologies most of us experience often, and it's always illuminating to understand what's happening behind the scenes, how we got here and where it's all heading.

Lastly, for many Australians it could well be time to ensure your internet access is completely unrestricted. Tor has been around for a while and is just about the only sure way to guarantee total online freedom. Page 68 for that quite possibly essential guide.

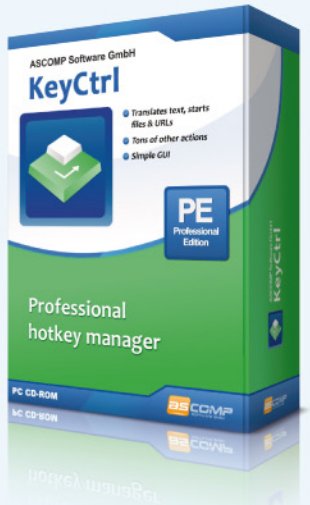
See you in a month!

> "The summer and new year period is one where you combine doing nothing whatsoever, with the things you've been putting off all year and know you really must tackle sooner or later."

Exclusive downloads

Your free full-version apps as a thanks for reading *APC*. These exclusive downloads will only be available for a limited time, from 13/01/25 to 02/03/25.

Download these *APC* exclusives free from: **www.apcmag.com/exclusives**



ASCOMP KEYCTRL

CREATE KEYBOARD SHORTCUTS. OPTIMISE WORKFLOWS!

Ascomp KeyCtrl is the perfect tool for anyone looking to boost productivity and streamline daily tasks on Windows. While popular shortcuts like Ctrl+C and Ctrl+V are invaluable for copying and pasting, Ascomp KeyCtrl goes beyond the basics, allowing you to create customised keyboard shortcuts tailored to your specific needs. Imagine executing complex tasks with a simple key combination: automatically inserting frequently used text in your email client or Word, translating website content in real time, taking instant screenshots, or quickly opening your most-used folder in Windows Explorer. With Ascomp KeyCtrl, all this and more is possible.

Ashampoo®
BURNING STUDIO
2025
VIDEO
MUSIC
COVER EDITOR
COPY
M DISC
ashampoo

ASHAMPOO BURNING STUDIO 2025

POWERFUL BURNING SOFTWARE FOR FILES, MUSIC, AND MOVIES.

Ashampoo Burning Studio 2025 provides a comprehensive solution for burning CDs, DVDs, and Blu-rays. It efficiently writes various file types, including music and videos, to different media, inclkuding BDXL and high-security discs. Importing music CDs is straightforward, with automatic track identification and naming. Designing covers and cases is user-friendly. Copying audio CDs and other discs is seamless. During ripping, playlists are created to maintain the desired music order. If a disc lacks sufficient storage, the disc spanning feature distributes data across multiple discs, allowing for secure storage and easy restoration of large photo, document, or music collections.

audials
radio
2025
SPECIAL EDITION
audials radio 2025

AUDIALS RADIO 2025 SPECIAL EDITION

YOUR PRACTICAL RADIO RECORDER.

A radio player with over 100,000 stations offers an almost unlimited selection of music, news and entertainment. This diversity allows users to discover stations from all over the world and enjoy different genres and formats. Whether local stations or international radio stations, the possibilities are endless. Another way to expand your own music collection is to record radio stations. In this way, the collection is supplemented by a broad spectrum of music and the listener can secure valuable treasures from the radio. Simply select a music category and Audials Radio Edition will fill your hard disk with music for free! You can also record radio plays with a time control.

DISCLAIMER Future Publishing is not the licensor of the exclusive software or any documentation included with it. Rather, Future is merely a distributor of the software, and your use of the software is subject to any accompanying third-party licence terms. You must carefully read and comply with any such third-party licence terms, together with all instructions and README files that come with the software. Accordingly, to the maximum extent permitted by law, all software is provided by Future 'as is' and without warranty either express or implied, and Future will not be liable for any damage that you may incur as a result of using any software downloads. You should back up any important system and data files before using any downloaded software. We recommend that you do not use the exclusive software on a production machine. Nothing in this disclaimer excludes any warranty that may be implied by statute, which may include the Trade Practices Act. While we have taken all reasonable steps to check the software downloads for viruses, we cannot guarantee that it is free from viruses or other harmful code and you should check each download using a virus scanner complete with the latest antivirus updates before use.

thermaltake

WARRANTY VOID IF REMOVED
thermaltake
TOUGHPOWER SERIES
TOUGHPOWER GF A3 850W

P O W E R T H A T L A S T S

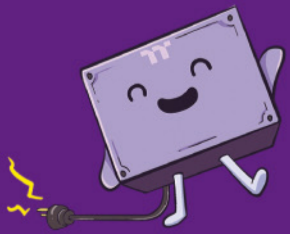
Toughpower GF A3 Gold Power Supply

650W | 750W | 850W | 1050W | 1200W

80 PLUS GOLD | **ATX 3.0** Compatible | PCIe Gen **5.0 Ready** | **10 Year** Warranty | CarePlus

Powering Peace of Mind

TT CarePlus, Thermaltake's trusted warranty service for your Power Supply.



✓ Stress-Free
✓ Local Support
✓ Swift-Replacement

FIND OUT MORE

www.thermaltake.com.au

CONTENTS

This month in *APC*

HOW TO

ALWAYS RUN THE LATEST & SAFEST DRIVERS & APPS

60 Don't let outdated programs compromise the security and performance of your PC. Robert Irvine explains how to ensure you're always running the latest and safest versions.

33

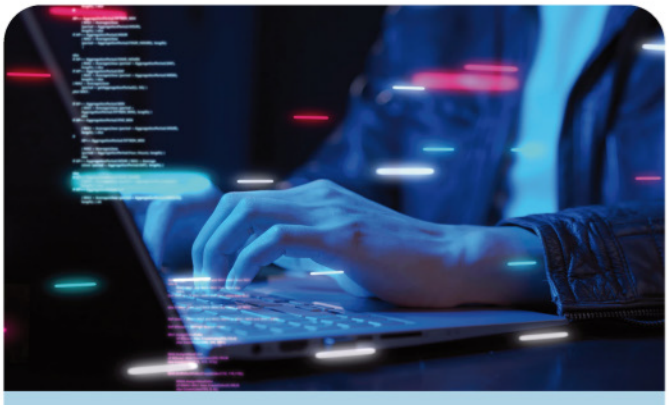
LG UltraGear™ OLED

39

41

52 **A brief history of Ray Tracing**

Nate Drake discovers how ray tracing was implemented in computer graphics and revolutionised art, movies, and video games.



56 **The race for advanced encryption**

Nate Drake tells the story of how the first Data Encryption Standard transformed the cryptography landscape.

> “Do you choose a random bit of hardware that you turn to on an almost daily basis? Or that bag of plug adapters and cables, just in case you need to charge your phone in some random car or airport lounge?”

Jon Honeyball - **One More Thing**
page 15

INSIDE

Technotes

08 News
What’s been going on in the world of techology in the news that affects you

10 Tech brief
Microsoft makes funeral plans for Windows 10

12 End user
Valve is getting ready to disrupt the whole gaming space

13 Tech talk
CPU gaming showdown – 9800X3D vs Core 9 285K

14 Trade chat
Can Nvidia make Arm chips work for gaming?

15 One More Thing
When travelling, there’s one item that Jon Honeyball never leaves behind

18 Autopsy
Meta Quest 3S

20 A-list
The best products on the market as rated by the *APC* team

24 Head to head
MyFitnessPal vs Cronometer

26 Gadgets
New things you don’t really need but will surely want

The Lab

29 Apple M4 series
30 AMD Ryzen 9800X3D
32 Apple iMac M4

The Lab continued ...

33 Apple iPad Mini
34 Apple MacBook Pro M4
36 Lenovo Yoga 7i Aura
37 HP OmniBook Ultra Flip 14
38 MSI MPG 491CQPX 240Hz QD-OLED
39 LG UltraGear PR 39GS95QE
40 Turtle Beach Stealth 700 Gen 3
41 Teamgroup T-Create Expert DDR5-6000
41 XPG Fusion PSU

Software

42 WinDirStat 2.0.3, IrfanView 4.7, FGiles 3.7.11, WhoCrashed Professional
44 Ubuntu 24.10

Features

46 Integrated graphics shootout
52 A brief history of ray tracing
56 The race for advanced encryption
60 Never miss another software update
68 Why you must use Tor

PC Builder

76 System news
Mark Williams watches the survival games at Intel unfold

77 Market watch
A sampling of PC systems currently available

78 Blueprints
Value- and performance-driven hypothetical builds

How to

82 Q&A
84 Photopea, the free browser-based Photoshop alternative
88 Remove bloatware from Windows
92 Lock down your browser
94 Manage your iCloud drive
96 Easy de-archiving
98 Do more with your smartphone
100 Get live updates with the YouTube API

Downtime

102 Gaming reviews
High-performance playtime

106 Game changer
Path of Exile

110 Retro
Sony Playstation

114 Know How
Create a portable file vault

SUBSCRIBE NOW & SAVE OVER 40%
Turn to page 16 now to find out how

TECHNOTES

Everything you need to know from the month in tech

Intel launches new Arc B580 GPU

10% more performance than an RTX 4060 for $440.

Intel's second-gen Battlemage graphics tech is official, it's announced, it's real and it's here. Going by Intel's claims, the actual architecture looks pretty great, too. It's been updated to be more efficient, to deliver better utilisation and performance per graphics core and also sports improved ray tracing and AI performance. Indeed, dollar-for-dollar, it looks like Intel may now be able to match Nvidia for ray tracing performance.

But what about the bad news? Well, the new B580 and its B570 sibling are fairly low end cards. Nvidia is only aiming at marginally beating the Nvidia RTX 4060 for now.

As for key specs, the B580 is a 12GB card with a 192-bit bus, which gives it a much more powerful memory subsystem than the RTX 4060. Is has more bandwidth than the RTX 4060 Ti, too. And only the 16 GB version of the 4060 Ti can match or beat the 580's VRAM.

It sports 20 of Intel's Xe cores and by our reckoning 2,560 shaders. That compares to 32 cores and 4,096 shaders of the existing top Intel GPU, the Arc A770. For the record, the Nvidia RTX 4060 features 3,072 shaders, though it's important to note here that Intel's and Nvidia's architectures aren't directly comparable

Overall, Intel is claiming that the B580 has the measure of the Nvidia RTX 4060 by 10% on average at 1440p while undercutting its $299 by around $50. Intel is leaning into the memory advantage of its new cards for 1440p gaming in particular and with ray tracing enabled. After all, the RTX 4060 is a mere 8 GB card with a 128-bit memory bus.

To achieve this performance, Intel has made various tweaks to Battlemage's architecture versus the original Alchemist GPUs. Then headlines involve higher shader utilisation and lower software overheads.

Details include 3-way co-issue, 256 kB L1 cache, an upgrade from 16 MB L2 cache to 18 MB and a larger pixel cache. But perhaps the most significant overhaul involves the RT engines.

The traversal pipelines and box intersections have a 1.5x performance increase over Alchemist while triangle intersections and the BVH cache are both 2x faster. All told, Battlemage certainly seems to have a very competitive ray-tracing engine.

Windows 11 Mixed Reality support revived

FOR META QUEST 3, QUEST 3S HEADSETS.

Microsoft recently announced an unexpected revival of its retired Mixed Reality feature, which was deprecated in every official way apart from for HoloLens back in December of last year. This Mixed Reality revival for Windows 11, though, will be limited to current and upcoming Meta Quest headsets, specifically the Meta Quest 3 and Meta Quest 3S for now. The three features Microsoft flaunts for this integration are "Immersive and private productivity", "Windows 365 Cloud PCs," and "Easy PC connection." The latter is self-explanatory, and the first two relate to the ability to navigate and use Windows 11 via virtual Mixed Reality monitors – the difference being whether you're using your own PC or opt to pay for a Windows 365 Cloud PC.

Intel, Microsoft

LG stops making Blu-ray players

DIGITAL KILLING OFF THE LAST REMNANTS OF PHYSICAL MEDIA.

In a disappointing turn of events, LG has ended production of its Blu-ray player series, which includes the UBK80 and UBK90 models. With limited stock available, prospective buyers should act quickly to secure the last remaining units before they are sold out.

After Samsung and Sony's departure from physical media, LG was one of the last major manufacturers of Blu-ray players. The pace of innovation slowed down, as did the frequency of newer models, and to no one's surprise, LG has decided to exit the Blu-ray market.

The ramifications of this change are profound, and feeds concerns about the hot topic of digital ownership – where your rights to the media you purchased can be taken away at any time.

Welcome to the Gemini era

Google's next generation of Gemini is here

GEMINI 2.0 IS ALL ABOUT DELIVERING AGENTIC EXPERIENCES.

You can now start trying out the new Gemini 2.0 Flash experimental model. This release delivers not just some big speed improvements over 1.5, but also big upgrades to the model's ability to generate multimodal output, merging text, audio, and imagery. You can give it a spin by choosing the chat optimised version of Gemini 2.0 Flash with Gemini on the web – and coming soon to the app.

Agentic AI is all about not just thinking, but doing, and empowering these systems to work through more and more complex problems and actually implement solutions. Back at Google I/O in May, we learned about Project Astra, an agent that tapped into our phones' cameras to function as sort of a next-generation, interactive Google Lens, letting the user ask questions about what they're shooting.

China levels anti-trust charges against Nvidia

ACCUSES CHIPMAKER OF VIOLATING ANTI-MONOPOLY REGULATIONS.

As the trade wars escalate between the US and China, Nvidia has found itself in the crossfire following accusations of possible anti-trust violations by the Chinese Government. The probe scrutinises Team Green's purchase of the Israeli-American networking firm Mellanox in 2020. Mellanox is the backbone of Nvidia's AI servers. The $7 billion acquisition was approved by Chinese authorities, stipulating that Nvidia will not use this partnership to discriminate against domestic firms. Likewise, Nvidia was obligated to notify rivals about upcoming products within 90 days. Coming hot on the heels of another wave of sanctions on 140 Chinese companies – now prohibited from importing High-Bandwidth Memory (HBM) among other chip-making tools – a retaliatory response was expected.

John Carmack envisions a GPU with Linux onboard

JUST ADD POWER AND A DISPLAY.

Legendary video games developer John Carmack, the leader programmer for iconic titles such as *Doom*, *Quake*, and *Wolfenstein 3D*, made the case for what one might casually describe as a standalone graphics card.

Perhaps the card could have a compact Linux distro onboard, mused the iconic Doom developer. It could even come with a handful of apps and utilities and connect to a keyboard via DisplayPort...

"It would just be fun if GPUs made their own video signal with diagnostic information when you apply power outside of a host system," the video games programming guru wrote. "You could go further and put a tiny Linux system running BusyBox on your command processor, and backchannel keyboard input through the display port if you don't have a USB port."

For some enthusiasts and gamers, the GPU is their PC's single largest, most important, and most expensive component. It seems to be primarily because of this that a mini-PC meme is emerging, where users add a PC onto their graphics card rather than a GPU to their PC system. Perhaps that is our destiny, and Carmack predicted it today...

TSMC founder slams Intel

SAYS THE COMPANY HAS NEITHER A STRATEGY NOR A CEO.

Intel's failure to offer a competitive AI processor is evident, which gives Morris Chang, the founder of TSMC, reason to claim that Intel should have focused on the development of AI processors rather than on making chips using leading-edge nodes. The TSMC icon also said that Intel had neither a strategy nor a new CEO, and that finding both will be difficult.

"I do not know why Pat resigned," said Chang at a press conference dedicated to the publication of his biography. "I do not know if his strategy was bad or if he did not execute it well." [...] "Compared with AI, he seemed to focus more on becoming a foundry. Of course, now it seems that (Gelsinger) should have focused on AI." ■

Google, Taitra, John Carmack on X

Microsoft makes funeral plans for Windows 10

Extended support tariff and nag screens are ready for the October deadline.

Microsoft is busy making preparations for when Windows 10 reaches end of support in October 2025, including an option to keep paying for support for the first time.

Windows 10 is still by far the most used version of Windows in the world, with six in ten active Windows installations still running Windows 10, according to the October 2024 data from Statcounter. That presents Microsoft with an enormous problem, with it looking increasingly likely that Windows 10 will still have a greater installed base than Windows 11 by the time the operating system is officially retired in less than a year's time.

Extended support

The danger of leaving hundreds of millions of Windows PCs without critical security updates is one that Microsoft has faced down in the past by continuing to provide post-deadline patches. Although extended support officially ended for Windows XP in April 2014, the company made three further emergency security patches to the operating system in 2014, 2017 and 2019 to head off major threats.

Likewise, even though extended support for Windows 7 came to an end in January 2020, the company announced an Extended Security Updates programme for businesses that would provide an additional three years of security patches, albeit for a significant fee.

This time around, Microsoft is inviting both consumers and businesses to take out Extended Security Updates (ESU) if they're not able or willing to part with their Windows 10 machines by the 14 October deadline.

> “Windows 10 is still by far the most used version of Windows in the world, with six in ten active Windows installations still running Windows 10, according to the October 2024 data from Statcounter.“

“For the first time ever, we're introducing an ESU program for personal use as well,” said Microsoft's executive vice president and consumer chief marketing officer, Yusuf Medhi, in a blog post. “The ESU program for consumers will be a one-year option available for US$30. Program enrolment will be available closer to the end of support in 2025.”

Business will have their own ESU, with prices starting at US$61 per device for the first year, and punitively doubling each year thereafter. The business scheme will run for three years, rather than the single year of the consumer version. But there's also a sting in the tail for businesses who join the ESU late: those who decide to join in year two must also pay the year one fee, as ESUs are cumulative.

What if consumers don't buy?

The question hanging over the new scheme is what will happen if a sizeable proportion of consumers

© Getty

and businesses decide they won't pay the $30 or more that Microsoft wants for extended support. Will the company be forced to issue free critical patches for major vulnerabilities, as it has in the past?

Some security experts believe Microsoft is forcing businesses to make unenviable choices. "While this is a strategy for Microsoft to encourage the transition to newer operating systems, it places users and businesses in a balancing act between security and cost," said James McQuiggan, security awareness advocate at security firm KnowBe4.

He added: "For individuals and smaller organisations with limited budgets, the additional costs may discourage continued support, potentially pushing them to continue with vulnerable systems and exposing them to additional security risks. Upgrading hardware presents a difficult challenge for industries with legacy systems, like manufacturing or healthcare."

Others argue it's too risky for either consumers or businesses to leave that to chance. "Putting off upgrading to the latest operating system can put you in a very vulnerable position as you will effectively raise a red flag to threat actors who could potentially attack your device remotely," said Jake Moore, global cybersecurity advisor at ESET.

It should be obvious, but it is always safest to use the latest, most up-to-date operating system as it will come packed with the latest security patches which keep threats at bay. Those sitting on the fence should consider the potential cost of losing their sensitive or financial data which is targeted by criminals."

As ever, he believes some will be forced to take the extended support because they're relying on software or hardware that's incompatible with Windows 11. "Extended support is likely to be expensive in an attempt to encourage users to upgrade to their latest version," Moore said. "But it'll possibly come down to the amount of machines that require a certain version of Windows which are currently compatible with bespoke software and could cost more to upgrade those locally."

> "It is always safest to use the latest, most up-to-date operating system as it will come packed with the latest security patches which keep threats at bay. Those sitting on the fence should consider the potential cost of losing their sensitive or financial data which is targeted by criminals."

Nag screens are back

Microsoft will use another familiar tactic to try and convince the Windows 10 laggards to upgrade their PCs: nag screens.

In September, Microsoft issued update KB5001716 to all versions of Windows 10 and one of the very early versions of Windows 11. According to Microsoft's notes: "After this update is installed, Windows may periodically display a notification informing you of problems that may prevent Windows Update from keeping your device up-to-date and protected against current threats.

"For example, you may see a notification informing you that your device is currently running a version of Windows that has reached the end of its support lifecycle, or that your device does not meet the minimum hardware requirements for the currently installed version of Windows."

If past history is anything to go by, users can expect the nag screens to grow more aggressive as time passes. With Windows 7, the end-of-support warnings started with desktop notifications in spring 2019, almost a full year before the operating system reached end of extended support in January 2020.

They were followed by unavoidable full-screen alerts shortly after the support date had passed, warning users they were putting their security at risk by continuing to use an unsupported operating system. The only way to disable those warnings was by deleting registry keys.

Even now, there are many millions of PCs still operating on Windows 7, with Statcounter reporting the ancient OS still accounts for 2.6% of all Windows installations. ■

Valve is getting ready to disrupt the whole gaming space

Steam Deck is only the beginning of what may prove a revolution, writes Shaun Prescott.

It looks like a new "death of the console" crisis is looming. Sony and Nintendo are still selling bucketloads of consoles, mind you, but Valve has widescale disruption in its sights.

Cast your mind back ten years ago when Valve unveiled Steam Machines, which were basically small form factor gaming PCs using a Linux-based OS to power a console-like version of Steam (then called "Big Picture Mode"). I loved the idea at the time, but few others did, and while some third-party companies like Alienware did their best to make their version of the Steam Machine happen, several factors stopped them from blossoming. Alienware co-founder Frank Azor told me in 2016 that part of the reason for the failure was that Windows 10 fixed all the gaming-centric problems that Windows 8 had introduced, undermining Valve's move Linux-ward. But more broadly, the Steam Machine just didn't gain any mindshare in the mainstream. No one knew what they were.

In 2024 things are different. The Steam Deck, which finally launched in Australia in November, is basically a trojan horse for Valve's bigger plans to secure a massive part of the console turf. Anyone who's used a Steam Deck knows that it's an incredible evolution of the console experience: it has a slick UI, more games than all of the other platforms combined, and Valve doesn't stop you from at least trying to run games that are beyond the specs or form factor. It also doubles as pretty much the best emulation machine going around. Above all, if all you want is to download games that are guaranteed to run on it, and to never do any fiddling at all, the Steam Deck lets you have that experience too.

One drawback is that its specs aren't quite powerful enough to run blockbuster games at high settings, but it is after all a handheld, and Valve seems to have other plans for the living room experience. Earlier this month a Reddit user datamined evidence of a device codenamed Fremont, which basically looks like a modern Steam Machine. Running parallel were leaks of a new Steam controller and a wireless VR headset with trackable wands. These could gain some serious momentum in light of Steam Deck's proof that Valve knows how to make a gaming device that not only equals its competitors in the user experience department, but betters all of them in terms of flexibility.

Microsoft, of course, wishes it were Valve (or that it owned Valve). In mid-December it announced 400 new games for its Xbox app, many of which support Xbox Play Anywhere. While Microsoft releases its own games on Steam, it would clearly prefer to own the dominant PC gaming digital storefront. That's a monumental task for which Microsoft is terribly ill-suited because let's be honest: Steam as a product has the benefit of over a decade of iteration, it implements features on the regular that are genuinely useful, and Microsoft just isn't agile or daring enough to attempt things that won't make them big dollars within a matter of years. Not to mention that Epic Games' attempts to meaningfully challenge Steam hasn't gained much traction despite multiple millions of dollars spent doling out free games as incentives.

So yes, the console may be dying, but it will likely be reborn not in Microsoft or Sony's visions, but Valve's. As for Nintendo, well, they will just do them. ■

Shaun Prescott is an Australian editor for PC Gamer, GamesRadar and PLAY, and writes for APC, TechRadar and more.

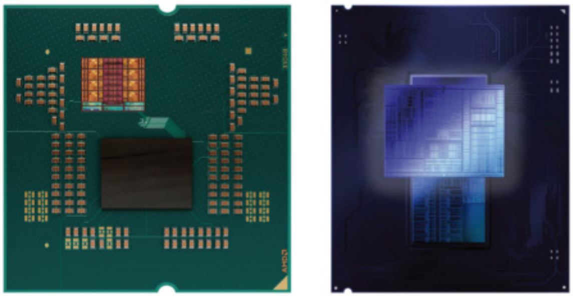
CPU gaming showdown: 9800X3D vs Core 9 285K

AMD's newest X3D CPU is looking like it's the super star chip of a generation.

You can't swing a GPU without The past month has been both exciting and underwhelming. Intel had a lot riding on Arrow Lake. The third iteration of Intel's desktop CPU architecture, it got an upgrade from the Intel 7 process node used with Raptor Lake to TSMC's N3B. AMD replied with the 3D V-Cache enabled 9800X3D, based on the Zen 5 architecture.

From the sidelines, Arrow Lake sounded like the more impressive design. Multi-tile chips leveraging a variety of manufacturing nodes, with a renewed focus on efficiency? Sounds great. Toss in the new Lion Cove performance cores and Skymont efficiency cores, and it felt like Intel's race to lose. Using stacked L3 cache has proven effective in boosting gaming performance, but otherwise, Zen 5 X3D didn't sound that exciting. How wrong that line of thinking turned out to be.

AMD Zen 5 X3D on the left in green, and Intel Arrow Lake on the right in blue (chips not to scale). The relative simplicity of AMD's approach wins out in the end.



© AMD/Intel

AMD reworked the 3D V-Cache to move the extra die under the main CPU die. This is critical, as the stacked cache acted as a blanket, trapping heat inside the processing cores and limiting top clocks and safe voltage ranges. With the cache under the chips, AMD delivers about a 10 percent gen-on-gen improvement in real-world CPU clocks. Coupled with a 15 percent increase in IPC (instructions per cycle) from the new architecture, and the Ryzen 7 9800X3D could deliver up to 25 percent higher performance than the 7800X3D.

Contrast that with Arrow Lake. The design is more reminiscent of the previous-generation Meteor Lake laptop processors, as opposed to this year's Lunar Lake refresh. Both chips use four main tiles, plus the Foveros interposer, while Lunar Lake has two tiles. More critically, Intel made several key changes that hurt performance in latency-sensitive workloads, like gaming.

The memory controller sits on the IO tile. This was perhaps a cost-saving measure, as external memory interfaces wouldn't scale much with the more expensive N3B process node. But now, all core accesses to system RAM need to jump through extra hoops, and memory latency ends up 15nm slower than on Raptor Lake chips. If that was the only change, Arrow Lake may have fared better. However, Intel also switched from separate E-core clusters to interspersing the E-cores throughout the CPU tile and sharing the unified L3 cache. But E-cores and P-cores run on different clock domains, and with Intel's ring bus interconnect, that creates more issues with latency.

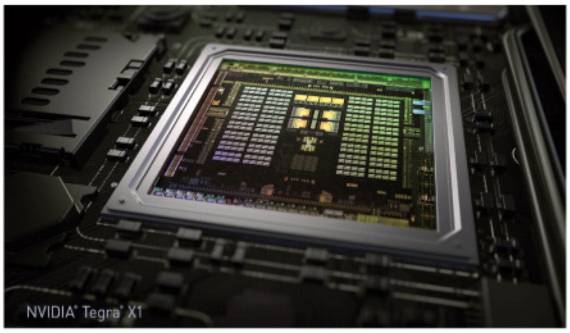
The net result is that Arrow Lake delivers great gains in efficiency, and for applications that aren't as sensitive to latency, a modest improvement over Raptor Lake. But games are usually slower on the new Core Ultra 9 285K compared to the Core i9-14900K, never mind the Ryzen 7 9800X3D.

Arrow Lake actually feels like AMD's first-generation Ryzen processors: great for multi-threaded workloads, but not when it comes to gaming. Intel has promised firmware updates, which should let the 285K match the 14900K in gaming. But depending on the gaming test suite, at 1080p ultra with a fast GPU like the RTX 4090, the 9800X3D may still keep a 25 percent margin of victory. Why didn't Intel put a fat cache on top of the IO tile? Maybe we'll get that with Nova Lake. ■

Jarrod has been described as an AI by people he meets at parties.

The next big frontier for Nvidia

Can Nvidia make Arm chips work for gaming?



Nvidia has produced Arm chips before, but these new SoCs are rumoured to be a huge step up.

The latest whispers claim that Nvidia will put a new SoC into production in September 2025, and that it will be aimed at 'high-end' PCs. Of course, games are the one thing that Arm chips still struggle with. But if anyone can crack that conundrum, it's Nvidia, right?

Allegedly, Nvidia is plotting Arm chips engineered in partnership with MediaTek and fully custom in-house designs. It's the version aimed at consumer PCs that will supposedly be pure Nvidia, while MediaTek will partner with Nvidia to create another Arm-based SoC for enterprise customers.

The enterprise chip probably needs 5G connectivity built in, hence the MediaTek tie-up. MediaTek is one of very few outfits capable of building 5G into an SoC, but the consumer PC chip, probably for laptops, maybe for handhelds or even desktops, doesn't have that requirement, giving Nvidia a free hand to design it exactly how it wants.

Anyway, precisely where in the market Nvidia will pitch its this Arm-based newcomer isn't clear. But surely it will lean heavily into Nvidia's utterly dominant graphics technology. After all, if it doesn't, what's the point? There are plenty of alternatives with good CPU cores but unremarkable GPUs.

It feels fair to assume that Nvidia's Arm chip will have the best raw graphics performance on the planet. The unknowns are twofold. First, what will the CPU cores be like? Nvidia has the option of buying in some ready-made core designs from Arm itself. That wouldn't be a terrible option, but equally, it wouldn't be very exciting.

Moreover, Apple has proven that Arm chips can be more than competitive with any of Intel and AMD's x86 cores. The latest Apple M4 CPU cores crank out as much as 60 percent more performance per clock than the best x86 processors.

Nvidia doesn't have a lot of form when it comes to designing CPU cores, but nor did Apple, and you can't doubt the scale of Nvidia's resources or its technical nous. Likewise, Qualcomm has come out of nowhere with its Oryon Arm-based cores in the Snapdragon X chip for PCs, further confirming the ability of the Arm instruction to be competitive. You'd have to give Nvidia a decent shot at creating a seriously competitive CPU.

In that context, the endeavour may hinge on Nvidia's ability to get games running on its new chip. The problem is that PC games are built for the x86 instruction set, not for Arm. PC games are also sensitive to any performance dips or latencies, so while it is theoretically possible to run an x86 PC on an Arm chip through emulation, the results are virtually guaranteed to be suboptimal.

Arguably, Nvidia needs to work with game developers to recompile at least some of their catalogs for Arm. For most companies, this would be a non-starter. It would be too costly, take too long, and the required relationships with the game development industry just wouldn't be there. But Nvidia has the closest ties with game devs of any hardware vendor. Literally every PC game dev optimises their output for Nvidia graphics.

In other words, if any company is in a position to get a critical mass of games ported to Arm, it's Nvidia. ■

Jeremy has a black leather jacket just like Jensen's.

© Nvidia

If you could choose one thing…

When travelling, there's one item that Jon Honeyball never leaves behind.

It was one of those three-pints-down discussions, when one of my friends turned and asked "what's your most prized and useful piece of kit?"

Sounds simple, but this is difficult to answer after one pint let alone three. Do you choose a random bit of hardware that you turn to on an almost daily basis? Or that bag of plug adapters and cables, just in case you need to charge your phone in some random car or airport lounge? Although I try to avoid plugging anything USB into an unknown source: who knows what evil handshaking might be going on down the cable?

For some, it was their "go everywhere" computing device. Phones were disallowed, because everyone has one. So the voting included a Surface Pro laptop, an iPad Pro and obvious contenders like noise-cancelling headphones.

You won't be surprised to hear that I decided to go left-field. I could have chosen any of the above, and depending on the trip, they would have been with me. But there is one item that travels everywhere with me, whether it's thrown in the back of a car for a visit, or taken on a long haul flight to the other side of the planet.

And that something is my Peli 1510 Laptop Overnight Case.

It's just the right size to hold everything I need for a short trip, even for a day or so away if I pack carefully. There are pouches for power and cables. A 14in laptop is no problem, but it can cope with a 16in laptop with a squeeze. In the main body, I can choose between a simple zip-lidded unit into which anything can be thrown, including clothes. Or go for the full "make any shape you want" in the foam padding, with TrekPak inserts that are ideal for a camera and multiple lenses. The inserts can be changed in a matter of a few seconds between empty, inserts and full foam sections.

To say the Peli 1510 is built like a brick outhouse would do a disservice to such structures. I can sit on it. I could probably stand on it to. The handle is extremely robust, with none of that nasty clicking tubular handle extension nonsense that others use. The wheels have no issues with rough terrain either. And it's waterproof, dustproof (IP67) and drop-proof, with the reassurance of a lifetime warranty.

It is, therefore, the very definition of a reliable piece of kit that goes with me everywhere, and has done for over a decade.

There are downsides, of course. First, the static weight is a little high, but the robustness makes up for all of that. And it has a certain militaryesque air that might be off-putting in a more artistic environment.

Plaster it with appropriate stickers, in keeping with hotel-checked baggage and conference materials, and it takes on a certain menacing air that shows you mean business. And I defy anyone not to be impressed by the loud clunk the latches make when you close the lid. ■

> "Do you choose a random bit of hardware that you turn to on an almost daily basis? Or that bag of plug adapters and cables, just in case you need to charge your phone in some random car or airport lounge?"

Jon Honeyball is aware there are cheaper alternatives to the case, but then it wouldn't be a Peli, would it?

Subscribe & save over 40%

The best value way to get *APC*

LAPTOP GAMING SHOOTOUT
INTEGRATED GRAPHICS COMPARED
apc
#541
JAN 2025
YOUR EXPERT GUIDE TO TODAY'S TECH
SINCE 1980
New Apple M4 is here!
Apple MacBook Pro & Apple iMac, PLUS Apple iPad mini
Lenovo Yoga 7i Aura
Slim, smart, stylish & stunning!
BYPASS ALL INTERNET TRACKING & CENSORSHIP
How to use Tor for complete online freedom
Clean Windows
How to remove bloatware
HOW TO
ALWAYS RUN THE LATEST & SAFEST DRIVERS & APPS
• Scan for outdated apps • Download without any junk
• Get alerts for new programs
IMAGE EDITING
HOW TO USE PHOTOPEA
THE FREE BROWSER-BASED PHOTOSHOP ALTERNATIVE
GOD-KING CPU
RYZEN 9800X3D
"THE SUPERSTAR CHIP OF A GENERATION"

SCAN ME

Simply scan the QR code above with your smartphone camera

At just **$7.04 per issue** for a 24-issue subscription, you'll save a huge 41% off the regular price – and with all the convenience of home delivery!

Lock in the low price and guarantee yourself 24 issues of Australia's greatest tech mag for just $169.

Print or digital? It's your choice!

Enjoy the traditional print edition, or if you prefer we offer digital magazines for both Android and Apple, and they're just $4.99 per issue!

LAPTOP GAMING SHOOTOUT
apc
ALWAYS RUN THE LATEST & SAFEST DRIVERS & APPS
HOW TO USE PHOTOPEA
RYZEN 9800X3D

APPLE OFFER
Free 30 day *APC* app subscription trial.
Read our latest issue free today

ON iOS & ANDROID!

The Apple edition for iPhone, iPad and iPod touch
tinyurl.com/APCAPPLESTORE
From $4.99 an issue

The Zinio edition for all Android devices
apcmag.com
From $4.99 an issue

Subscribing is quick and easy

SCAN the QR code and follow the prompts, **VISIT** www.techmags.com.au **or CALL** (02) 8227 6486

SCAN ME

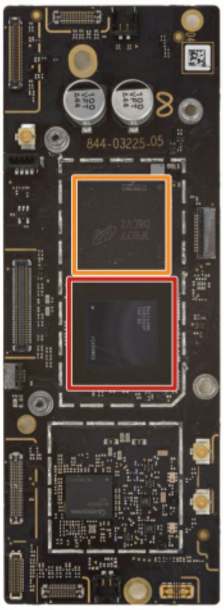
TERMS & CONDITIONS: This offer expires February 9th 2025, and is available to subscribers within Australia only. Please allow 6-8 weeks for delivery of your first issue. For full terms and conditions, see: http://techmags.com.au/style/images/FutureTC.pdf Please see our privacy policy on page 3. *Six issues for $59, then $59 charged to your credit or debit card every six issues thereafter on auto-renewal.playback; 32x22x1.7cm; 1.78kg.

AUTOPSY

This month we dissect...

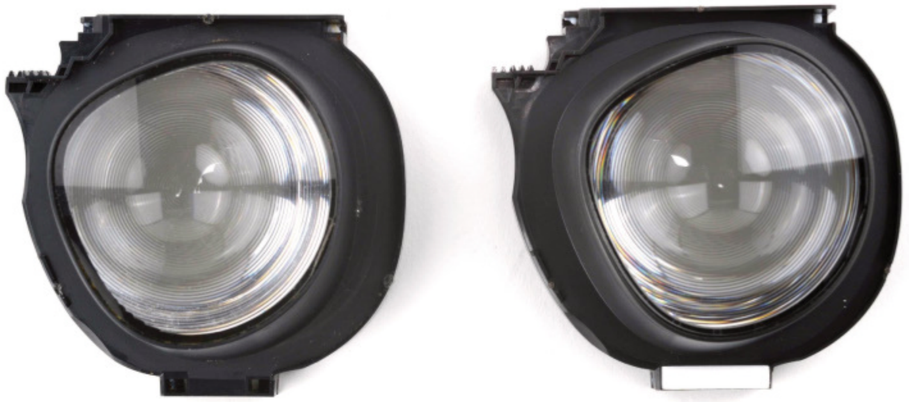
Meta Quest 3S

The Quest 3S is not a budget version of the Quest 3. Yes, it has the Quest 3's redesigned speaker arms, colour passthrough, and the Snapdragon XR2 Gen2 SoC. But the 3S is really a true successor to 2020's Quest 2.



The Qualcomm Snapdragon XR2 Gen 2 SoC is the one major spec item that's shared with the Quest 3.

The same fresnel lenses are a dead giveaway that the Quest 3S is actually more closely related to the Quest 2 than the Quest 3.

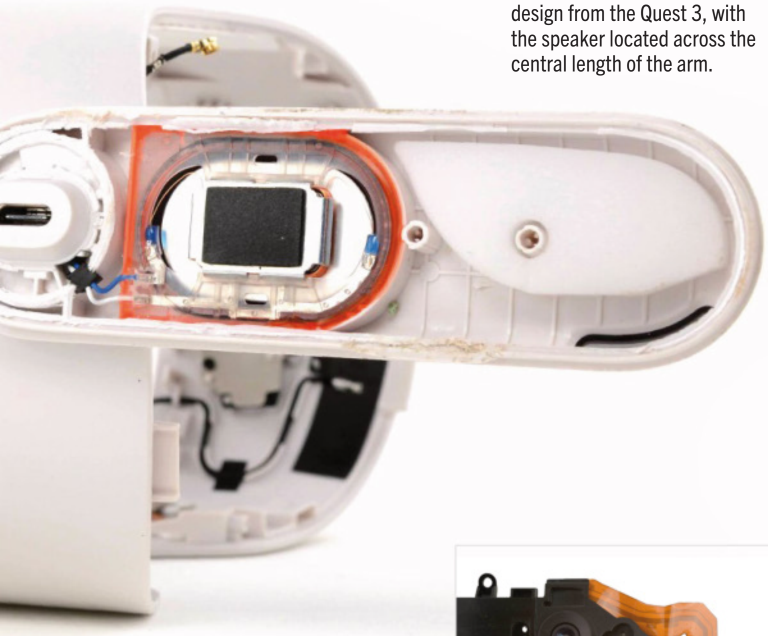


ABOUT IFIXIT

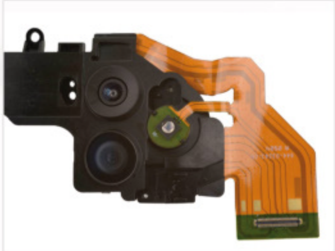
iFixit is a global community of tinkerers dedicated to helping people fix things through free online repair manuals and teardowns. iFixit believes that everyone has the right to maintain and repair their own products.

To learn more, visit www.ifixit.com

Because the Quest 3S and Quest 2 share some critical components, we have the ability to salvage broken old Quest 2s and repurpose parts.



The speaker arms borrow their design from the Quest 3, with the speaker located across the central length of the arm.



The 3S sports dual RGB passthrough cameras, four integrated cameras, and two IR flood illuminators, but no proximity sensor.

The battery housing retains the same design as before, but the battery connector itself has changed as a result of losing that proximity sensor.

META QUEST 3S: MAJOR TECH SPECS

- 120Hz LCD display, 1,832 by 1,920 resolution per eye
- Fresnel lenses, 97 degree horizontal field of view, 20 pixels per degree
- Qualcomm Snapdragon XR2 Gen 2 SoC, Octa-core Kryo CPU (1 x 3.19 GHz, 4 x 2.8 GHz, 3 x 2.0 GHz)
- Dual RGB passthrough cameras, 58-68mm IPD range (manually hardware adjustable, 3 fixed IPD settings), 6 DoF Inside-out via 4 integrated cameras
- 8GB RAM, 128GB storage (256GB optional)
- 2x Meta Quest Touch Plus Controllers, capacitive face buttons, capacitive joystick, capacitive touch pad, capacitive index trigger, middle finger triggers
- WiFi 6E, Bluetooth, USB-C

KEY FINDINGS

- The most obvious difference between the Quest 3 and Quest 3S is in the optical stack. Meta saved themselves some local processing power by opting for the bulkier but cheaper-to-implement Fresnel lenses, just like the ones in the Quest 2. No, 'just like' isn't right. They are the ones used in the Quest 2. These parts are 100 percent compatible with each other.
- If we make our way past the optical stack and to the screen, we'll find the same LCD panel being used too. This is the same RGB stripe LCD panel that the Quest 2 uses, right down to the display panel connector.
- The most important change is the spec bump from the 7nm Qualcomm Snapdragon XR2 Gen1 SoC with 6GB of RAM to the 4nm Gen2 SoC with 8GB of RAM. This is the main similarity between the Quest 3 and Quest 3S. With it is a wireless IC upgrade, bringing WiFi 6E and BT 5.2 support.
- The battery housing retains the same design, but the connector has changed as a result of losing the proximity sensor. Without this, the Quest 3S appears to be on a timed auto-shutoff, which is a reduction in complexity, and an easy way to solve what was a nasty problem.
- The speaker arms have also borrowed their design from the Quest 3, with the circular speaker-as-a-fulcrum design from the Quest 2 swapped for a speaker across the central length of the arm. This should improve audio quality when compared to the Quest 2. Unfortunately, somebody at Meta forgot to include the headphone jack during this transition. Of all the places a headphone jack would be most appreciated, surely immersive gameplay would be one?
- In another design departure, a rare iterative improvement over the Quest 3, the depth sensor has been swapped for two IR flood illuminators. The sensor suite has been redesigned to give it a sharp and somewhat arachnid aesthetic. Each cluster of sensors consists of one of the aforementioned IR illuminators, an RGB passthrough camera, and a tracking camera, with two sensors mounted under the device, pointing down for body, hand, and controller tracking.
- Repairability Score: 6 out of 10 (10 is easiest to repair). Because the Quest 2 and Quest 3S share some critical components, we have the ability to salvage broken Quest 2s. This helps reduce the carbon footprint of both devices by allowing an avenue for the reuse of components in this next generation. This shows why it can be so beneficial to lean into existing technologies and manufacturing processes. ■

Find the best deals
on new gear at
getprice.com/au

The A-List

The best products on the market, as picked by our editors.

Premium laptops

NEW

Apple MacBook Pro M4

ONE OF THE BEST LAPTOPS THAT'S EVER BEEN MADE.

This M4 update to the already brilliant MacBook Pro line is an easy recommendation, so the big question becomes do you choose the 14in version or 16in. But whatever you choose should last for years, and look great while it's doing it.

From $2,499, apple.com/au

THE ALTERNATIVES

ASUS ZENBOOK DUO
A dual-screen laptop that uses a practical layout and excels at everyday use. The unique form factor is incredibly handy for those who need dual screens on the go.
$3,999, asus.com

APPLE MACBOOK AIR
The MacBook Air M3 replaces the M2 model previously listed here. It's a powerful and quiet ultraportable with an unbeatable battery life and screen.
From $2,099
apple.com/au

MICROSOFT SURFACE LAPTOP 7
A shining example of just how good a Windows laptop can be. Despite a few minor drawbacks, the Surface Laptop is a fantastic package that offers performance and battery life.
$1,899, microsoft.com

Business laptops

HP OmniBook X

THE QUALCOMM CPU REALLY DELIVERS.

The latest Qualcomm CPU helps create a standout laptop that will impress compared to Intel powered alternatives. The OmniBook X has been on sale across all major retailers for $2,079. At this sort of price the X is the cheapest Snapdragon X Elite laptop going, and a compelling buy.

From $2,079, hp.com

THE ALTERNATIVES

DELL LATITUDE 7340
This 1.1kg laptop offers terrific battery life and, if you choose the better non-touchscreen (look for 400 nits of brightness in the specs).
$2,475
lenovo.com/au

ASUS ZENBOOK S 16
The Asus Zenbook S 16 offers premium performance in the ultraportable category and competes well with alternatives such as the Surface Laptop 7 or Macbook Pro.
$3,499, asus.com.au

NEW

LENOVO YOGA 7I AURA
The Lenovo Yoga Slim 7i Aura is a sleek, versatile laptop with a great display, excellent build quality, and solid performance, and is an especially good buy when on sale.
$2,799, lenovo.com /au

Gaming laptops

Alienware m16 R2

A PREMIUM AND AFFORDABLE GAMING & WORK MACHINE.

There are cheaper gaming laptops, and faster ones too, but we love the balance offered by the m16 R2. Who doesn't want a big 16in gaming laptop, featuring a Ultra 9 CPU, a RTX 4070 GPU and 32GB of RAM? And for a decent price, considering it's from Alienware.

$3,300, dell.com

THE ALTERNATIVES

LENOVO LEGION 5I
Best in class performance from the powerful RTX 4070 GPU and stand out features such as 140W PD charging.
$3,499
lenovo.com/au

ACER NITRO V 16
It's a cheap and cheerful gaming laptop, but that's exactly what the Nitro V series does best, and overall this new 16in model offers great bang for buck.
$1,500
store.acer.com

ASUS ROG STRIX SCAR 18
It's expensive, but if you want an 18in laptop that delivers all-out power this is the no-compromise 3.1kg beast to buy – it packs quality everywhere.
From $4,599
asus.com/au

Everyday laptops

Asus Zenbook S 13 OLED

ASUS AND INTEL TEAMED UP TO BUILD A MACBOOK AIR KILLER.

A compact and budget friendly Ultrabook that's the best available device for many on-the-go professionals. Compared to the MacBook Air 13, it has an additional HDMI and USB-A port, an SSD that's roughly twice as fast, and the screen is brighter and offers rich OLED contrast.

$2,099, asus.com

THE ALTERNATIVES

ACER SWIFT 14 AI (INTEL)
The Acer Swift AI 14 is a great overall package, and while the $2,399 RRP feels steep, we've seen it discounted to $1,800, making it an excellent buy.
$2,399
acer.com

APPLE MACBOOK AIR 15
An awesome plus-size MacBook Air with great battery life and graphical performance. GPU performance and battery life are the standout perks here. **From $2,199**
apple.com/au

LENOVO YOGA SLIM 7X
This is almost everything we could want in a Windows laptop, and offers a compelling mix of features, strong performance and amazing battery life.
$2,909, lenovo.com

Chromebooks

Acer Chromebook Spin Core 5

Simply the best Chromebook around. Others may beat the 12th gen Intel Core i5 we tested for performance, but for features, design and bang for buck you won't find any laptop that can match this convertible. **$997, acer.com**

Lenovo Flex 3i Chromebook

This isn't the most powerful Chromebook, but students need reliability more than power – especially if they're only really using it for homework, note-taking, and perhaps the occasional bit of Netflix.
$367, lenovo.com/au

Lenovo IdeaPad Duet

The Chromebook answer to Microsoft's Surface tablets, this is a seriously versatile device – albeit not the speediest (although we never found it to be painfully slow while carrying out everyday tasks). For this price, and with a 16hrs 14mins battery life, the Duet is a great choice.
$297, lenovo.com/au

Tablets

Apple iPad Air (M2)

We love the new iPad Pro, but for most people the M2 iPad Air is not only far better value but also all the tablet they'll need. It supports the Magic Keyboard and Pencil Pro, plus it's now available in both 11in and 13in sizes.
From $1,299, apple.com/au

Apple iPad Pro (M4)

The best tablet in the world becomes even better thanks to Apple's stunning M4 chip, a gorgeous OLED screen and the must-have accessory: the all-new Pencil Pro. But it comes with an obvious downside of cost, with the cheapest 13in incarnation costing $2,199.
From $2,199, apple.com.au

Samsung Galaxy Tab S9 Ultra

This 14.5in tablet offers a size and versatility that even the iPad Pro can't match, with its high price more than justified by the quality of Samsung's AMOLED panel, speakers and productivity software.
$1,999, samsung.com

Everyday monitors

Asus ROG Swift OLED PG32UCDP

We've seen several ultimate gaming monitors in recent months but, from the specs alone, Asus might just have made the most *ultimatest*: 480Hz refresh rate, matte-screen HDR OLED, 32-inch 4K.
$2,399, asus.com.au

BenQ BL2790QT

A 27in, 1440p monitor that's packed with quality, from its brilliant OSD to several clever features designed to fight eye fatigue. Text and images look sharp and punchy, its USB-C docking capability is always welcome, and the speakers are surprisingly decent.
$459, benq.com

LG UltraGear 32

The new LG UltraGear 32GS95UE-B. AAU is not perfect. But it does a pretty comprehensive job of blowing every existing 32-inch 4K gaming monitor based on Samsung's QD-OLED panel tech into last year.
$2,399, msi.com

Professional monitors

Eizo FlexScan EV3240X

With images that whack you between the eyes as soon as you lift it, fully assembled, from its box, this 32in 4K monitor is our top choice pick for anyone willing to make such a hefty long-term investment.
$2,696, eizoglobal.com

Eizo ColorEdge CG2700X

A brilliant choice for professional designers, whether working solo or in teams, thanks to its dedication to providing accurate colours across potentially years of life. It's also bang up to date for connectivity, with USB-C and RJ45 making it easy to manage.
$5,500, eizoglobal.com

Asus ProArt Display PA278CFRV

While it costs too much for casual users, workers and gamers, for professional designers, it's an attractive proposition with easy-to-access, designer-friendly tools and presets.
$629, **asus.com**

Home office printers

Epson EcoTank ET-2810

Don't expect flashy features, but do expect fast print speeds, high-quality prints, scans and copies, plus phenomenally low running costs – even after you've exhausted the 6,000 pages' worth of bottled ink that comes with it.
$399, epson.com.au

HP OfficeJet Pro 9012e

So long as your print volumes aren't huge – the running costs mount up – this is a superb all-in-one for home office usage. It's fast, robust, prints double-sided and produces strong all-round results.
$228, canon.com

Brother MFC-J4540DW

Home workers will love this inkjet all-in-one. It combines an incredible range of features with all the connectivity you need and extreme ease of use. Output quality is fine, it offers the best cloud support around and the high-capacity ink pack could keep you going for years.
$329, brother.com

Find the best deals
on new gear at
getprice.com/au

Wireless routers

Synology WRX560

Its quad-band Wi-Fi smashed-through our performance tests managing 791.5Mbps up close, 375Mbps two rooms away and an amazing 216.7Mbps down the garden.
$419, synology.com/au

Asus ROG Rapture GT-AX16000

The most splendid, overpowered router on the market. But, it's silly money and aspirational to most users. Ultimately, though, it's currently the highest-spec consumer router available.
$999, asus.com/au

Netgear Nighthawk RS700S

Make no mistake – you won't get stunning speeds out of this Wi-Fi 7 router today. But if you must buy a router now and want future-proofing, this is a solid choice. But honestly, we would recommend that you wait.
$1,499, netgear.com

Mesh Wi-fi

TP-Link Deco XE200

There are cheaper Wi-Fi 6E meshes, but the XE200 wins for its superb download speeds, excellent coverage and the fact that older clients reap benefits of 6E, not just new ones. And a two-pack should be enough for most premises.
$1,299 (2-pack), tp-ink.com

TP-Link Deco X20

The Deco X20 makes it possible to upgrade your home network to Wi-Fi 6 for the price of some standalone routers. The HomeCare functions are also a great bonus for households where lots of devices are fighting over the bandwidth. **$227 (2-pack), tp-link.com**

Asus ZenWiFi AX

The interface and design certainly aren't the prettiest (the charcoal version is straight out of the 1980s), but if you're after strong performance, great features and plenty of expansion potential, the ZenWiFi AX is a compelling prospect.
$939 (2-pack), asus.com/au

NAS servers

Asustor Nimbustor 4 Gen2 AS5404T

A particularly strong choice as a media server, the updated Nimbustor 4 is both flexible and quick. Asustor's Nimbustor 4 AS5404T is a four-drive NAS enclosure aimed at demanding home users or small offices.
$889, asustor.com

QNAP TS-264

The TS-264 combines strong specifications and performance for a reasonable price. We wouldn't choose this NAS as a starting point for a small business, but it is a good choice as a home NAS if you'll be using it for both work and entertainment.
$649, qnap.com

QNAP TS-253E

The TS-253E is a sensible business NAS that's ideal for rolling out to multiple small offices. If you're buying for business, and particularly if you've got an eye on minimising support headaches across a group of premises, this is an excellent choice.
$858, qnap.com

Security software

Avast Ultimate

Buy from retail and this is a bargain, with a solid VPN, anti-tracking software and handy detection fees on top of excellent protection.
~$65, 1 device, avast.com/en-au

THE ALTERNATIVES

G DATA TOTAL PROTECTION
Despite its quirks, G Data provides straightforward, effective and inexpensive protection against malware and other threats to your system. **1 device, US$50, avast.com**

AVAST ONE ESSENTIAL
Essential has the same malware-detection engine as our top choice, but for free. It even includes 5GB of VPN services per month and a few system optimisation tools.
Free, avast.com

NordVPN

NordVPN provides consistent and fast speeds, serious security, great support for video-streaming services and some cost-effective subscription rates.
$59 per year, nordvpn.com

THE ALTERNATIVES

PROTONVPN
ProtonVPN provided one of the best free offerings of all the VPNs in our group test, including unlimited data, but upgrade to benefit from even faster speeds and many more options.
Free, protonvpn.com

SURFSHARK
A strong rival to NordVPN, especially if you're willing to commit to its two-year contract. It's fast, cheap and a fine choice for people who like to switch to US streaming services.
$79.61 for one year, surfshark.com

Bitwarden

Bitwarden has a huge advantage: it's free. It isn't as slick as some paid-for rivals, but it can sync passwords across all devices for no extra charge. **Free, bitwarden.com**

THE ALTERNATIVES

DASHLANE
A manager that's ideal for beginners, and it even builds in an unlimited (if basic) VPN service. Note you may prefer to buy the Family plan ($60 per year) as this extends the service to six people.
$55.99 per year (Premium), dashlane.com

1PASSWORD
1Password is targeted at users who are looking for the last word in security. It even offers a Travel Mode that may ease your mind if surrendering your phone to customs officials. **$54.99 per year (individual), 1password.com**

msi®

MSI MPG 321URX 240HZ AND 271QRX 360HZ

ENDGAME QD-OLED MONITORS

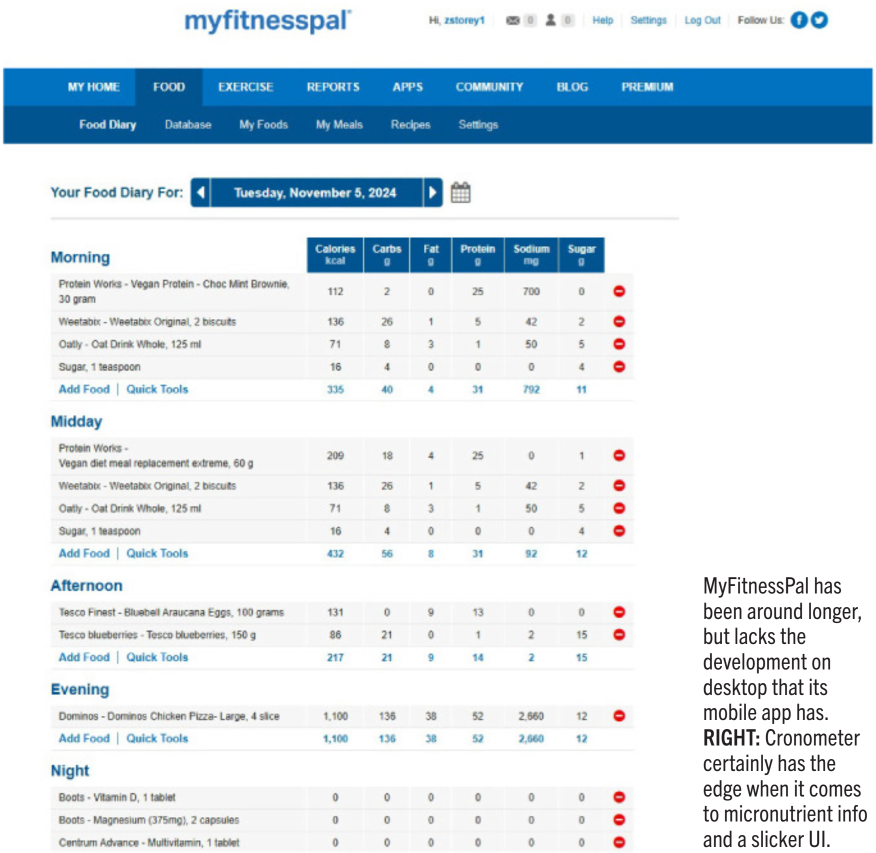
MPG
MSI PERFORMANCE GAMING
msi

GET THE ULTIMATE VISUAL EXPERIENCE.

Take your immersion to the next level with stunning OLED performance—enjoy up to 360Hz refresh rate, 4K resolution and 32" and 27" display sizes.

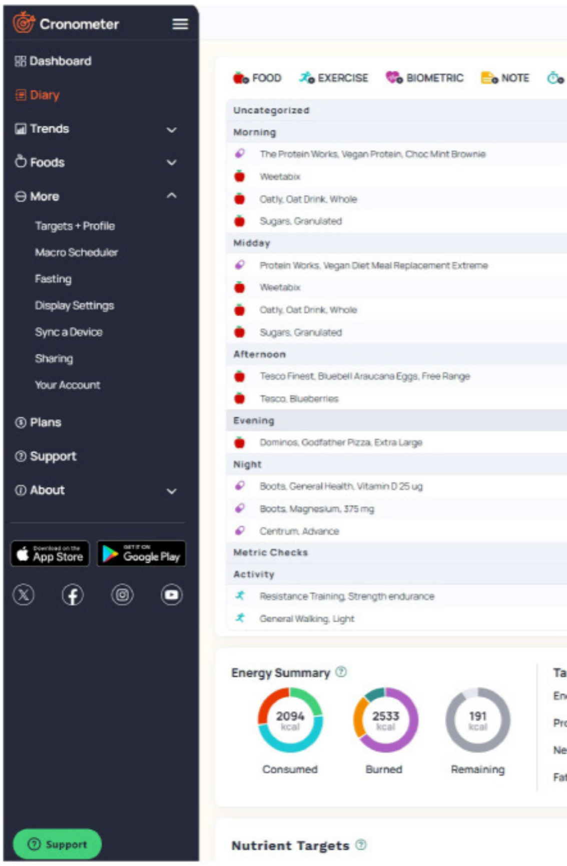
SHOP NOW

LEARN MORE AT MSI.COM



Your Food Diary For: Tuesday, November 5, 2024

Morning	Calories kcal	Carbs g	Fat g	Protein g	Sodium mg	Sugar g
Protein Works - Vegan Protein - Choc Mint Brownie, 30 gram	112	2	0	25	700	0
Weetabix - Weetabix Original, 2 biscuits	136	26	1	5	42	2
Oatly - Oat Drink Whole, 125 ml	71	8	3	1	50	5
Sugar, 1 teaspoon	16	4	0	0	0	4
Add Food | Quick Tools	335	40	4	31	792	11
Midday						
Protein Works - Vegan diet meal replacement extreme, 60 g	209	18	4	25	0	1
Weetabix - Weetabix Original, 2 biscuits	136	26	1	5	42	2
Oatly - Oat Drink Whole, 125 ml	71	8	3	1	50	5
Sugar, 1 teaspoon	16	4	0	0	0	4
Add Food | Quick Tools	432	56	8	31	92	12
Afternoon						
Tesco Finest - Bluebell Araucana Eggs, 100 grams	131	0	9	13	0	0
Tesco blueberries - Tesco blueberries, 150 g	86	21	0	1	2	15
Add Food | Quick Tools	217	21	9	14	2	15
Evening						
Dominos - Dominos Chicken Pizza- Large, 4 slice	1,100	136	38	52	2,660	12
Add Food | Quick Tools	1,100	136	38	52	2,660	12
Night						
Boots - Vitamin D, 1 tablet	0	0	0	0	0	0
Boots - Magnesium (375mg), 2 capsules	0	0	0	0	0	0
Centrum Advance - Multivitamin, 1 tablet	0	0	0	0	0	0



Uncategorized

Morning
The Protein Works, Vegan Protein, Choc Mint Brownie
Weetabix
Oatly, Oat Drink, Whole
Sugars, Granulated

Midday
Protein Works, Vegan Diet Meal Replacement Extreme
Weetabix
Oatly, Oat Drink, Whole
Sugars, Granulated

Afternoon
Tesco Finest, Bluebell Araucana Eggs, Free Range
Tesco, Blueberries

Evening
Dominos, Godfather Pizza, Extra Large

Night
Boots, General Health, Vitamin D 25 ug
Boots, Magnesium, 375 mg
Centrum, Advance

Metric Checks

Activity
Resistance Training, Strength endurance
General Walking, Light

Energy Summary
2094 kcal Consumed
2533 kcal Burned
191 kcal Remaining

Nutrient Targets

MyFitnessPal has been around longer, but lacks the development on desktop that its mobile app has. **RIGHT:** Cronometer certainly has the edge when it comes to micronutrient info and a slicker UI.

MYFITNESSPAL $14.99 per month / $79.99 per year, www.myfitnesspal.com
CRONOMETER $14.99 per month / $89.99 per year, www.cronometer.com

MyFitnessPal vs Cronometer

Zak Storey tests which reigns supreme in the world of diet tracking?

Look, we get it, nutrition and fitness is a bit left field for *APC* – it's not something we often cover. That said, it's an integral part of all our lives, and the better we look after ourselves, the more time we can spend in good health with our loved ones, doing the things we enjoy (namely, tinkering with PCs). Staying inside of healthy weight ranges is one of the best and most effective ways of reducing the risk of all-cause mortality. It's almost at the level of being a complete panacea in a lot of measures.

The science has come a long way in recent years, so much so that we now have a far better understanding of how human metabolism works, how hormones and genetics affect it, and how best to manage it if you're aiming to lose body fat or gain muscle. In my case, I'm both a traditional field archer on weekends and a calisthenics enthusiast (body weight control) on weekdays. To improve my performance in both of those areas, it's imperative that I get physically stronger while controlling my weight. That means I need to keep a close eye on my nutrition and weight.

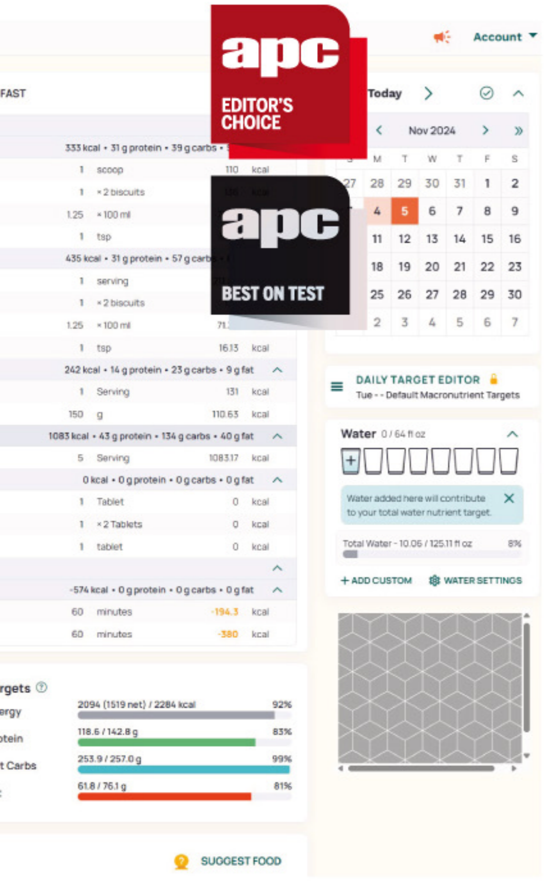
Fortunately, there's software and digital solutions out there that can help in this regard, the most famous of which being MyFitnessPal. It launched all the way back in 2005 as a simple website designed to allow users to track their daily calories and food intake. Developed by Mike Lee in 2009, it launched on iPhone, and since then has gone from strength to strength, becoming one of the go-to apps for those looking to keep tabs on their calories in and out.

In 2015, it was bought by sports and fitness apparel manufacturer Under Armour for an incredible US$475 million, before being sold to a private equity firm in 2020. MyFitnessPal has an absolutely huge arsenal of features embedded into it, the most prominent and important of which being its food database. In short, you can effectively scan the barcodes of food to import them and their nutritional information into the app. From there, you can then count your macro-intakes along with calories, add exercise expenditure, and set weight targets.

Cronometer is certainly the underdog out of the two. Also established in 2005, built up as a side project by Aaron Davidson, it's called Cronometer as it was built around the 'calorie restriction optimal nutrition' diet. This basically involves reducing calorie intake while maintaining suitable vitamin, mineral, and macro amounts based on your own body weight.

Side-by-side comparison

On the surface, both options provide very similar feature sets. Both have access to massive food databases globally; if you can think of a supermarket food item, it's


apc
EDITOR'S CHOICE
apc
BEST ON TEST
Account
FAST
Today
Nov 2024
333 kcal • 31 g protein • 39 g carbs
435 kcal • 31 g protein • 57 g carbs
242 kcal • 14 g protein • 23 g carbs • 9 g fat
1083 kcal • 43 g protein • 134 g carbs • 40 g fat
0 kcal • 0 g protein • 0 g carbs • 0 g fat
-574 kcal • 0 g protein • 0 g carbs • 0 g fat
DAILY TARGET EDITOR
Tue - - Default Macronutrient Targets
Water 0 / 64 fl oz
Water added here will contribute to your total water nutrient target.
Total Water - 10.06 / 125.11 fl oz 8%
+ ADD CUSTOM
WATER SETTINGS
rgets
ergy 2094 (1519 net) / 2284 kcal 92%
otein 118.6 / 142.8 g 83%
t Carbs 253.9 / 257.0 g 99%
61.8 / 76.1 g 81%
SUGGEST FOOD

likely on there. Both have various forms of macro tracking, allow you to build custom recipes, and feature smartphone apps on Android and iOS, with connectivity and integration with all manner of step counters and smart watches.

The differences come in the form of how that data is represented, particularly on desktop, where, let's face it, we're most interested. Without a doubt, Cronometer has an edge here. Without paying for premium on either platform, Cronometer's overall UI is far cleaner and more intuitive. If you go into the food diary section of each, Cronometer's is impressively digestible. At the bottom, you'll not only find your overall macro targets in bright, bold bars, but also easily legible pie charts on calorie consumption.

The far more interesting segment comes below, however, where Cronometer goes on to break down the entire nutrition profile of your daily consumption, covering everything from vitamin and mineral intake, to the recommended daily allowances for those nutrients. Hover over those bars, and it'll even give you information on what each vitamin does, which foods are rich sources of them, and then tell you what foods you're eating that contain the most of that nutrient in your day's diary above – all on a singular page.

MyFitnessPal doesn't offer the same granularity that Cronometer does here, mostly focusing on Macros. You can get a report for the entire week, but you have to individually select each nutrient you want to look at, loading a new page in the process. It makes it far more awkward to analyse if you're into that kind of thing. It's worth mentioning that you can monitor these elements with MyFitnessPal, but it does require you to sign up to the premium package.

Both platforms do also support weight goals, and calorie reduction targets as well. However, in another win for Chronometer, it does present information in a much more legible way as you add directly into your food diary.

Speaking of food, MyFitnessPal does have a larger database of food items available to it, which can be helpful when dialing in your food diary; it uses a mixture of user-submitted and general-access databases, which is somewhat problematic, as it can often mean a lot of those items aren't actually calculated correctly. Crono, on the other hand, uses lab-analysed databases instead, relying on NCCDB or the USDA for its nutritional information, among a few others. Both programs technically support barcode scanners as well on the mobile edition. However, that's now locked behind a premium paywall for MyFitnessPal, while its free on Cronometer. You can also create your own custom foods, but for Crono, as mentioned, that's locked to just you, so don't expect to find every McDonald's item on there unless you build them out yourself. Still, it's this accuracy that really gives Crono the edge.

Premium costs

Both MyFitnessPal and Cronometer provide premium paid options. MyFitnessPal comes in at $15 per month, or $80 for the year (including a one-month free trial), and that adds that barcode scanner back in, along with custom macros, better insights, workout plans, repeat daily meal planning, and an absence of ads.

Cronometer is far cheaper in comparison, and has two tiers of subscriptions (Gold and Pro). Cronometer Gold, coming in at $14.99 per month, or $89.99 for the year, removes ads, allows you access to repeat items, introduces nutrition scores and macro schedules, fasting timers, and gives you a ton more insights and chart creation tools on the site itself. Both really do provide similar extras, although Crono does seem to have the edge here too, certainly on cost.

Cronometer also has a Pro variant. This is predominantly designed for personal trainers and those working in the health and fitness industry. This is more of a management tool for your athletes rather than a personal tool, letting you set meal plans, analyse nutrition, and chat with your clients through a secure messaging platform if needed.

Dinner time

Ultimately, this is a very one-sided fight. Cronometer is much further ahead of what MyFitnessPal has today, whether that's food database accuracy, micronutrient information, the UI experience, or even general pricing and the free experience. If you're keen to get a handle on your diet, and are looking for a place to get stuck in, or are just fed up with MyFitnessPal's lack of detail, then Cronometer is a good step up.

One thing we want to caveat this review with is that as always, ensuring you're safe with your nutrition is of tantamount importance. Nothing is ever going to be 100 percent accurate. You need to use this information as a reference point, not as an absolute be all-and-end-all. In the same way that we use Cinebench to indicate rough CPU rendering performance, the same should be applied to these kind of tools. Similarly, please always consult a trained and certified nutritionist or medical professional before you begin any radical diet adjustments. Treat these applications as measuring tools, and use the information and knowledge they provide to back up and achieve your fitness ambitions without letting it control you. Bit of a serious tone, we know, but it's something that we felt needed addressing. ■

VERDICT

★★★½☆

MyFitnessPal Simple design with no fluff, and easy to use. Integrates with smart devices a touch better. Inaccurate food database though, and poor web UI. Paid sub required for basic features; Limited nutritional information.

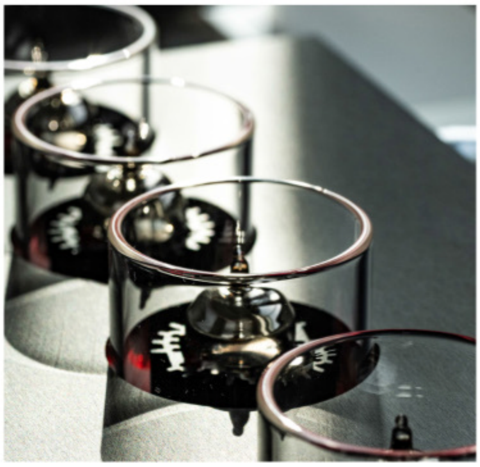
★★★★½

Cronometer Top-tier UI with far better pricing. Barcode scanner is free. Nutrient tracking far more advanced. Premium suite adds a lot of extra detail. Occasional trouble sharing exercise info across devices.

GADGETS

Nice things to have

EAT E-Glo II



The E-Glo II uses a cutting-edge all-tube design with no semiconductors in its signal path.

Now here's something to make you glow on cold winter nights – the glorious sight of old school valves on European Audio Team's E-Glo II. Stylish designed in black or silver, the E-Glo II is a dedicated phono stage that sits between your vinyl turntable and your hi-fi amplifier (or any other device that can handle a RCA phono input). Compatible with turntables fitted with either a Moving Magnet (MM) or Moving Coil (MC) cartridge, the E-Glo II adds up to 76 decibels of gain, amplifying the sound from the needle as it traces around your vinyl's grooves, so they can be picked up and further amplified by your hi-fi. Weighing in at a hefty 5.3kg and and made from premium materials, there's something rather lovely about this slice of audio esoterica. Fans of the slow movement will also enjoy the fact that it takes the valves up to 40 seconds to warm up ready for use.

$TBA, europeanaudioteam.com/henleyaudio.co.uk

Teenage Engineering OP-XY

Talk about going from one audio extreme to the other. While European Audio Team's E-Glo II is offering old-fashioned thrills, the OP-XY from Swedish wunderkinds Teenage Engineering couldn't be more modern. For here we have a performance sequencer, synthesiser and sampler all in one, fashioned in Teenage Engineering's renowned syle. Made in anodised aluminium, the OP-XY has all kinds of capabilties that'll make your party swing – from the ability to include eight individual instrument tracks and eight auxiliary tracks, to punch-in effects, and more.

$3,479, teenage.engineering

The OP–XY is a powerful sequencer, synthesizer, and sampler to help you create all kinds of incredible sounds.

groov-e Triton 3-in-1 wireless charger

From the expensive to the affordable – and at just $50, this three-in-one charger is a bargain. Available in black, the Triton foldable design opens up to reveal charging pad for your MagSafe-equipped Android, iPhone, AirPods and Apple Watch, delivering up to 15W of charging power to your phone, 3W to your AirPods (with wireless charging case) and 2W to your Watch. The only thing you need to add is a QC 3.0 adaptor for fast charging. The Triton even doubles as a stand, handy for when you want to use StandBy mode.

$50, amazon.com.au

VQ Halo

Why take a lantern and a Bluetooth speaker with you the next time you go glamping, when the VQ Halo can do both – and work as a power bank at the same time. Water-resistant to IPX4, the speaker can be used indoors or out and last for up to 10 hours on a single recharge, while it includes a USB-A and USB-C ports for charging other devices and is has an auxiliary input for non-Bluetooth sounds. As for the lamp bit, its LED has three lighting modes to help you light your way or read. And there's a romantic candlelight option too.

$TBA, amazon.com.au

EZVIZ HP3 Pro Video Doorbell

Now you can see who's at the door – even in the dark – with this affordable replacement for EZVIZ's EP3X Pro. Equipped with a 2K camera, colour night vision, and artificial intelligence (AI)-powered human detection, the HP3 Pro is water- and dust-proof to IP65 and includes a rechargeable battery with a solar panel included, in case you don't want to wire it in. Best of all the HP3 Pro also has 32GB of onboard memory, so you needn't pay for a cloud storage subscription, though, sadly, it's not HomeKit Secure Video compatible.

$TBA, ezviz.com.au

REVIEWS

Expert reviews and recommendations to help you buy with confidence

29 **Apple M4 series** 30 **AMD Ryzen 9800X3D** 32 **Apple iMac M4** 33 **Apple iPad Mini** 34 **Apple MacBook Pro M4**
36 **Lenovo Yoga 7i Aura** 37 **HP OmniBook Ultra Flip 14** 38 **MSI MPG 491CQPX 240Hz QD-OLED** 39 **LG UltraGear PR 39GS95QE**
40 **Turtle Beach Stealth 700 Gen 3** 41 **Teamgroup T-Create Expert DDR5-6000** 41 **XPG Fusion PSU**

APC is Australia's oldest consumer technology magazine – having been consistently in print for over forty years, since our first issue way back in May 1980 – and we take that heritage and responsibility very seriously. While our focus is obviously on the personal computer the very definition of the PC has changed and shifted markedly since the early 1980s. As such, we touch on many other areas of tech, too, from smartphones and apps to peripherals, accessories, and beyond. We have two goals: to find the best modern tech and to help you make the most of it.

Independent reviews

Championing technology doesn't mean we're unrelenting yes-men and -women, however, and *APC* aims to be as objective as possible in all our coverage. That means identifying the best products from multiple perspectives – the best performance, best value and best features and, ideally, the products that offer the best mix of these three attributes.

As a matter of policy, reviews published in *APC* are not shared with product-makers prior to print. We will contact vendors under certain conditions; for example, if we have a problem testing a product that seems to indicate it may be faulty, or to invite a vendor to clarify how a particular feature works. If an *APC* reviewer has any potential conflicts of interest involving a brand, the review will always be assigned to another writer.

Labs testing

APC strives to conduct the most rigorous, objective scientific tests and benchmarks we can so as to make our reviews as unbiased as possible. We use a variety of tools and programs for this, including many freely available benchmark suites for assessing media encoding, general system performance including storage read and write speeds, gaming and battery life.

APC EDITOR'S CHOICE

When a product scores 4.5 out of 5, it carries the Editor's Choice Award. These are products that exceed expectations and deliver a quality experience up there with the very best.

APC HIGHLY RECOMMENDED

You will see this award if a reviewed product has scored four out of five stars. It means most people can expect satisfying performance from the product, and that we would use it ourselves.

Apple M4 series

Don't expect revolution, but this is a notable all-round upgrade in performance for all members of the series. By John Loeffler.

COMPARISON CHART	M4	M4 Pro	M4 Max
CPU cores	Up to 10 (4P, 6E)	Up to 14 (10P, 4E)	Up to 16 (12P, 4E)
GPU cores	Up to 10	Up to 20	Up to 40
NPU	38 TOPS	38 TOPS	38 TOPS
Thunderbolt 5?	✗	✓	✓
Max memory	32GB	64GB	128GB

The Apple M4 series powers the iPad Pro along with the new Mac mini, iMac and MacBook Pro. Featuring what Apple calls "second-generation" 3nm core architecture, a faster neural engine and far more memory bandwidth, there's much to admire.

The plain M4 sits at the bottom and supports up to 32GB of unified memory (16GB is the new default). It provides 120GB/sec of bandwidth, a 17% jump on its predecessor. Perhaps more telling is that Apple claims that the M4 is up to 1.8x faster "in multithreaded performance" than the M1, and that the "performance core is the world's fastest CPU core" in terms of single-threaded tasks.

These hyperbolic claims aren't unusual for Apple, but there's good evidence to suggest they're justified. In particular, take a look at the Geekbench 6 single-core results in the graphs. Not only is the M4 significantly faster than the M3 family, but also a chunk faster than any other silicon we've tested.

The M4 comes with four performance cores and up to six efficiency cores, giving ten in total, so while it pushes the M4 Pro close in Geekbench 6's single-core tests it falls behind everywhere else. Note that if you buy an iMac, you can buy it with either eight CPU cores or ten CPU cores, and it's the same story for the GPU. Here, you're benefitting from hardware-accelerated ray tracing and mesh shading, with Apple promising that it's twice as fast as the M3 in ray-tracing tasks and up to 2.1x faster than the M1 for "graphically intensive tasks" such as 3D design. The Blender and Handbrake graphs give a clear indication of its power.

There's also the neural engine, which is capable of 38 TOPS compared to the Apple M3's 18 TOPS. This is exactly what you'll need if you want to take advantage of the new Apple Intelligence tools. It doesn't matter which version of the M4 family you buy: the neural engine (or NPU) is the same.

Apple sells the M4 Pro in two varieties: one with 12 CPU cores and 16 GPU cores, the other with 14 CPU cores and 20 GPU cores. Apple claims that the M4 Pro "delivers up to 45% faster multithreaded CPU performance than the M3 Pro", but that's for the 14-core version; note the two extra CPU cores are both performance rather than efficiency. Along with more memory – up to 48GB for a MacBook and 64GB for the Mac mini – it also comes with greater bandwidth, now up to 273GB/sec.

You also get support for Thunderbolt 5 while the M4 sticks with plain old Thunderbolt 4.

Finally we come to the M4 Max, which we haven't yet had a chance to test. This offers two more CPU cores than the Pro, with a maximum of 16 (four are efficiency cores, so you get either ten or 12 performance cores). Apple reckons it's up to 18% faster in multithreaded performance compared to the M3 Max, and 2.4x faster than the M1 Max.

But it's the GPU where the M4 Max really pulls ahead, with either 32 or 40 cores. Apple claims it's up to 25% faster than the M3 Max. The M4 Max supports up to 128GB of memory with a peak bandwidth of 546GB/sec, twice that of the M4 Pro and 30% more than the M3 Max. Finally, the plain M4 supports up to 15 streams of 4K ProRes video, while the Pro goes up to 37 and the M4 Max up to 66.

It adds up to a significant upgrade over the M3 family, and a huge lift over the M1 and M2.

Geekbench 6 single-core		
M4 Pro	14-core CPU, 20-core GPU, 48GB	3,910
M4	10-core CPU, 10-core GPU, 16GB	3,807
M3 Pro	11-core CPU, 14-core GPU, 16GB	3,168
M3	8-core CPU, 10-core GPU, 8GB	3,163
M3 Max	16-core CPU, 40-core GPU, 48GB	3,158
M2 Pro	12-core CPU, 19-core GPU, 16GB	Not tested

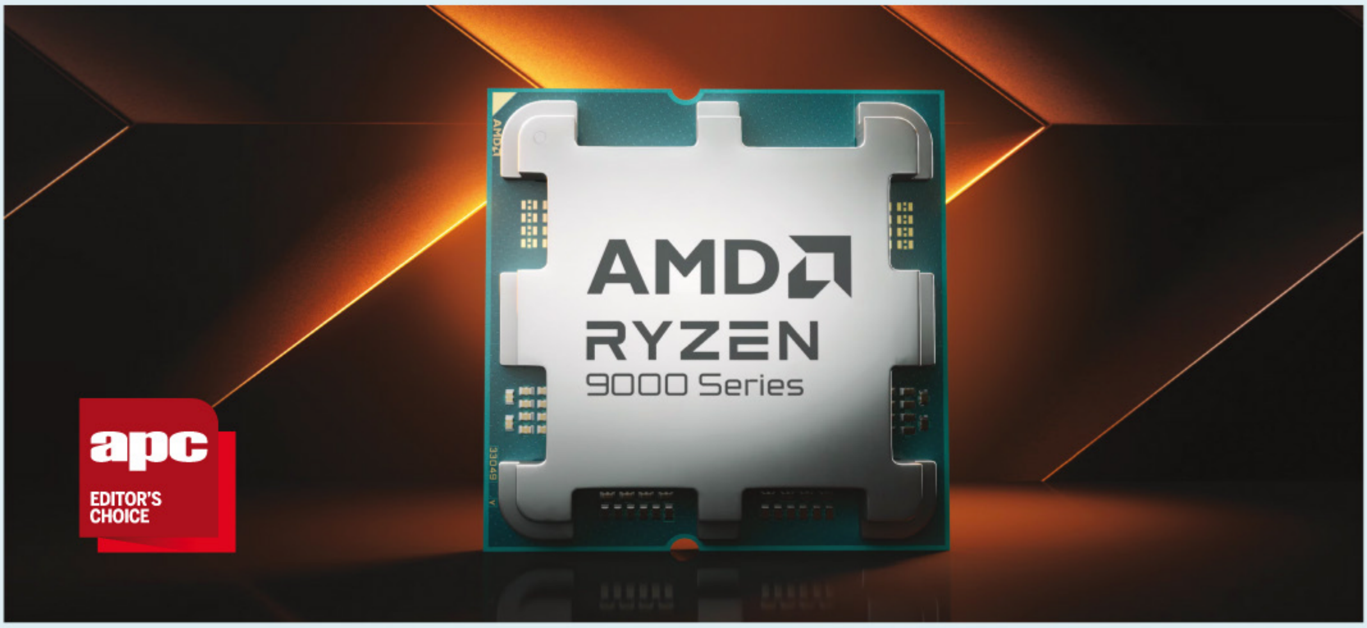
Geekbench 6 multicore		
M4 Pro	14-core CPU, 20-core GPU, 48GB	22,822
M3 Max	16-core CPU, 40-core GPU, 48GB	21,182
M4	10-core CPU, 10-core GPU, 16GB	15,114
M3 Pro	11-core CPU, 14-core GPU, 16GB	14,292
M3	8-core CPU, 10-core GPU, 8GB	11,968
M2 Pro	12-core CPU, 19-core GPU, 16GB	Not tested

Blender 4 monster (CPU)		
M3 Max	16-core CPU, 40-core GPU, 48GB	207
M4 Pro	14-core CPU, 20-core GPU, 48GB	200
M2 Pro	12-core CPU, 19-core GPU, 16GB	126
M4	10-core CPU, 10-core GPU, 16GB	116
M3 Pro	11-core CPU, 14-core GPU, 16GB	108
M3	8-core CPU, 10-core GPU, 8GB	83

Handbrake 4K to 1080p		
M3 Max	16-core CPU, 40-core GPU, 48GB	2mins 36secs
M4 Pro	14-core CPU, 20-core GPU, 48GB	2mins 39secs
M2 Pro	12-core CPU, 19-core GPU, 16GB	4mins 6secs
M3 Pro	11-core CPU, 14-core GPU, 16GB	4mins 26secs
M4	10-core CPU, 10-core GPU, 16GB	4mins 28secs
M3	8-core CPU, 10-core GPU, 8GB	5mins 38secs

Borderlands 3 1200p (average fps)		
M3 Max	16-core CPU, 40-core GPU, 48GB	57
M4 Pro	14-core CPU, 20-core GPU, 48GB	43
M3 Pro	11-core CPU, 14-core GPU, 16GB	29
M4	10-core CPU, 10-core GPU, 16GB	23
M3	8-core CPU, 10-core GPU, 8GB	20
M2 Pro	12-core CPU, 19-core GPU, 16GB	Not tested

Shadow of the Tomb Raider 1200p (fps)		
M3 Max	16-core CPU, 40-core GPU, 48GB	120
M4 Pro	14-core CPU, 20-core GPU, 48GB	79
M3 Pro	11-core CPU, 14-core GPU, 16GB	48
M4	10-core CPU, 10-core GPU, 16GB	36
M3	8-core CPU, 10-core GPU, 8GB	32
M2 Pro	12-core CPU, 19-core GPU, 16GB	Not tested



PRICE $829 **WEB** amd.com

AMD Ryzen 7 9800X3D

This is the one we've been waiting for: the first true gaming chip of AMD's new Zen 5 range.

The eternal battle for best processor goes on, and this month we test the latest salvo from AMD. The Ryzen 7 9800X3D is an out-and-out gaming processor, while Intel's Core Ultra 200K series (codenamed Arrow Lake) are all-rounders. In particular, they're the first x86 desktop CPUs to include a neural processing unit (NPU). So, in truth these are very different chips.

AMD spends the cache

AMD follows a similar approach to the 9800X3D as it did with the 7800X3D. It has the same 8-core/16-thread setup as the AMD Ryzen 7 9700X, but with an additional 64MB L3 cache to take the total to 96MB.

In the first iteration of 3D V-Cache, as AMD calls it, the extra die was stacked on top of the main processing cores, but in this second generation the extra cache die is underneath the main die, leaving the main processing cores free to directly interface with the CPU cooler.

This is a big deal, as the processing cores are where all the heat is being generated, so having an extra layer of silicon between it and the CPU cooler had many implications for what the 78003XD could do. Thermals had to be carefully managed, so clock speeds were kept in check and there was no ability to overclock the chip.

By moving the 3D V-Cache die underneath the main processor core complex, the thermal restraints around clock speeds and voltage no longer apply, so the 9800X3D is the first 3D V-Cache chip to feature full overclocking support. Compared to the AMD Ryzen 7 7800X3D, then, the 9800X3D benefits from noticeably faster base clock and boost clock speeds out of the box, along with far higher peak power demands.

Beyond that, the only major change is faster DDR5 memory support, rom 5,200MHz with the 7800X3D to 5,600MHz with the 9800X3D. Both chips support AMD EXPO overclocking for even faster memory speeds.

Speed test

So AMD talks a good game, but what really matters is whether it delivers. And

BENCHMARK RESULTS

1080p gaming performance	AMD Ryzen 7 9800X3D	AMD Ryzen 9 9900X	Intel Core Ultra 9 285K	AMD Ryzen 7 9700X
Cyberpunk 2077, RT Ultra, DLSS bal.	120	115	103	113
Metro Exodus Enhanced, High	151	147	137	149
Total War: Warhammer 3, High	159	167	139	164
3DMark Timespy CPU Index	15,513	17,160	17,668	14,278
Cinebench 2024 single core	132	136	141	136
Cinebench 2024 multi- core	1,336	1,805	2,390	1,190
CPU package power, peak Watts	131	162	243	88

SPECIFICATIONS	**Ryzen 7 9800X3D**	**Core Ultra 5 245K**	**Core Ultra 7 245K**	**Core Ultra 9 285K**
Core count	8P	6P + 8E	8P + 12E	8P + 16E
Thread count	16	14	20	24
Perf. core base clock	4.7GHz	4.2GHz	3.9GHz	3.7GHz
Perf. core boost clock	5.2GHz	5.2GHz	5.5GHz	5.7GHz
E-core base clock	N/A	3.6GHz	3.3GHz	3.2GHz
E-core boost clock	N/A	4.6GHz	4.6GHz	4.6GHz
L3 cache	96MB	24MB	30MB	40MB
NPU	N/A	13 TOPS	13 TOPS	13 TOPS
Base power	120W	125W	125W	125W
Turbo power	Not stated	159W	250W	250W

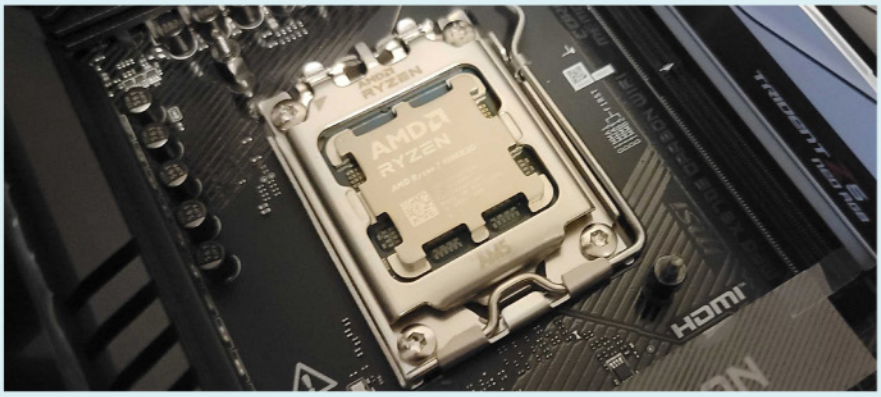
thankfully it does, albeit not universally. In the synthetic benchmarks, the Ryzen 7 9800X3D showed very strong single-core performance on a par with the rest of the Ryzen 9000-series lineup. The Ryzen 7 7800X3D, meanwhile, lags behind its Ryzen 7000 siblings due to the need to control thermals by limiting clock speeds. The Ryzen 9800X3D doesn't have this problem. Likewise, its multicore performance is also unconstrained, running ahead of the Ryzen 7 9700X across the board.

Generally, creatives need not concern themselves with the 9800X3D – though there is one exception. If you're a photographer or graphic designer who does a lot of work in Photoshop or its alternatives, the 9800X3D's extra cache is going to be a serious benefit for your workflows, beating even the Intel Core i9-14900K in PugetBench for Adobe Photoshop by a few hundred points.

Game on

It's gaming where the 9800X3D really shows off, with one caveat. In games where the main CPU bottleneck is game logic, the extra cache isn't necessarily going to help your game performance. You just need the fastest clocks possible. That's why Intel's previous-generation (and even current-gen) chips have an advantage in games such as Returnal, where complex bullet and geometry physics are the main CPU workload. Or *Total War: Warhammer III*, where a lot of individual actors need to have their logic calculated quickly.

Where 3D V-Cache really benefits gaming is when there's data being communicated from the CPU to the GPU, such as texture files or model geometry, and that additional cache memory can retain these smaller (but not tiny) files in the fastest possible memory that can hold it. Games such as *F1 2023* and *Tiny Tina's Wonderland* benefitted mightily from the extra available cache. In the case of the former, the Ryzen 9800X3D just wallops the Intel Core i9-14900K, and in the case of the latter, runs a very close second to it.



> "So AMD talks a good game, but what really matters is whether it delivers. And thankfully it does, albeit not universally."

With performance that comes in neck and neck with the best Intel processors in gaming workloads, the Ryzen 7 9800X3D would already be an incredible chip. But we can't get over the fact that the 9800X3D can do this with only 53% of the power of the Core i9-14900K. Add to that the Ryzen 7 9800X3D's impressive single- and multicore speed, surprisingly great Photoshop performance, and gen-on-gen gains at very little monetary cost, and the Ryzen 7 9800X3D is easily one of the best AMD processors ever made.

It's less good news for Intel's chips. They're slower than the processors they replace in too many areas, with the only obvious benefit being their lower power draw (an area where AMD clearly wins). To rub salt into the wound, you'll need a new motherboard to house the Core Ultra chips, and right now even a stripped-down offering costs $500. The performance and efficiency just don't make these compelling purchases on their own.

This premium means prebuilt PCs based around the Core 5 Ultra won't make sense for a while (too much of the price is swallowed by the board), but Core 7 and Core 9 Ultra systems may make sense depending on your usage.

But let's not mince words. Arrow Lake has missed the target, while the 9800X3D hits it bang in the middle. ■

VERDICT

★★★★★

AMD's latest gaming chip is the clear winner from the new batch of processors from AMD and Intel.

Ben Mansill & John Loeffler

apc
HIGHLY RECOMMENDED

PRICE From $1,999 **WEB** apple.com/au

Apple iMac M4

A gorgeous screen and speedy M4 chip make this a very desirable desktop.

Alongside new Mac mini and MacBook Pro models, Apple has updated its iconic all-in-one desktop. It's not a major redesign, but it brings some welcome improvements over last year's model – not just the latest M4 processor, but also a doubling of the starting RAM and a better webcam. The colour line-up has been updated too, with new shades of blue, green, orange, pink, purple and silver.

As always, the defining feature of the iMac is its screen, and that remains as delightful as ever. At 24in it won't dominate your desk, but it provides much more workspace than a laptop, and also works well for video streaming: I tried watching some of my favourite shows and movies on the iMac and was delighted by how bold and vivid the colours looked. It has lovely wide viewing angles too, so you needn't be stuck directly in front of it for media consumption.

As for app performance, Apple Silicon always feels snappy, but the M4 processor raises the ante with single-core and multicore Geekbench 6 scores of 3,646 and 14,724 respectively. That's 40% to 60% faster than its M3 predecessor, and around twice as fast as the M1 model.

Add in the fact that the entry-level RAM has now been doubled to 16GB and there's more than enough power here for any sort of productivity role. I found the iMac M4 was able to process video faster than its predecessors too, completing our 4K video-transcode test nearly two minutes faster than the iMac M3. And, like all M-series iMacs, it'll support all the current and upcoming features of Apple Intelligence.

A final plus point worth mentioning is the iMac M4's upgraded 12MP webcam. This does a great job of capturing fine detail during video calls, and in FaceTime it now supports "Desk View", which literally lets you share a view of what's on your desk in front of the iMac. Alternatively, you can use your phone as a secondary camera, via Apple's Continuity Camera feature, as long as you have a compatible iPhone.

The iMac M4 does have a few limitations. While it races through desktop tasks, gaming performance is less inspiring: even with a 10-core GPU and 24GB of RAM, my review system struggled with recent games. In *Baldur's Gate 3* I had to live with 20-30fps. In terms of ergonomics, the lack of height adjustment is a pain. Having to pile books beneath the stand to get it closer to a comfortable position cheapens the whole experience.

Finally, it's certainly not a new issue, but the iMac's continued lack of touchscreen support is becoming harder and harder to overlook. Now that modern Macs can run iOS and iPadOS apps, and even offer full iPhone mirroring, having to use a keyboard and mouse for everything feels distinctly backward.

Despite those gripes, it's impossible to dislike the new iMac. The faster processor won't greatly change the experience for most people compared to the M3 model, but if you do want to get stuck into video or photo editing the extra performance is certainly nice to have, and the extra RAM ensures things will keep running smoothly for a good long time to come. It's more than enough of an upgrade to maintain the iMac's position as one of the best desktop computers on the market. ■

SPECS 10-core Apple M4 with 10-core GPU; 16GB unified memory; 256GB SSD; 24in 60Hz IPS panel, 4,480 x 2,520 resolution; 2 x Thunderbolt 4/USB-C 4; 2 x USB-A 3.2 Gen 2; 1GbE port; Wi-Fi 6E; Bluetooth 5.3; 1080p webcam; Magic Mouse; Magic Keyboard with Touch ID; macOS Sequoia; 547 x 147 x 461mm (WDH); 4.4kg; 1yr RTB warranty.

VERDICT

★★★★☆

A minor upgrade, but when so much was already right it's hard to complain.

Alex Wawro

apc
EDITOR'S CHOICE

PRICE From $1,799 **WEB** apple.com/au

Apple iPad mini (2024)

A delightfully compact yet capable tablet that can go anywhere with you effortlessly.

If you're looking for a lightweight and compact tablet, the smart move might be to opt for the latest iPad mini. It's not a revolutionary update over the sixth-generation model, released in 2021, but a few under-the-hood improvements make it an all-round superior tablet that's well worth a look.

The design still resembles a shrunken-down iPad Air, and since it comes with iPadOS 18 preinstalled, you get all the same software features as found on the latest iPad Air and Pro models. Those include the upgraded Calculator app and the Smart Script feature, which cleans up your handwriting in real time to make it more legible. Perhaps more significantly, it's also in line to receive the full set of Apple Intelligence features – which the older sixth-generation model will miss out on.

Though diminutive, the tablet still feels solid, with a sturdy aluminium chassis that never budges or flexes. Around the edges you'll find the volume buttons, a lone USB Type-C port and a power button / Touch ID sensor, plus four stereo speakers, which produce a surprisingly big sound.

The 8.3in display is the same as the one on the previous model, with plenty of brightness and tasteful colour reproduction that looks vibrant but still realistic. Video looks beautifully sharp and rich, and the mini also makes a great e-reader for both text and graphical content. I found the bold contrast between the white pages and black inks brought out every detail in the pencil work in a manga like Dragon Ball.

My only reservation about the screen is that the refresh rate remains stuck at 60Hz, rather than the 120Hz of the latest iPad Air and Pro models.

One thing that has been upgraded is the chipset, with the old A15 Bionic processor now replaced by the A17 Pro, as found in the iPhone 15 Pro and iPhone 15 Pro Max. With a six-core CPU, a five-core GPU and a 16-core Neural Engine, the newer processor crushes the older mini 6 for performance. I found editing photos and videos on this tablet was a pleasure, and even when I had a dozen Chrome tabs and a YouTube video running, the iPad mini 7 never slowed down or stuttered.

Battery life remains more or less on par with the iPad mini 6. Our web-browsing test clocked up 10hrs 34mins of continuous surfing over Wi-Fi before the battery gave out; that's about 20 minutes less than the previous model, but is still plenty of power to get you through the whole day.

In all, the iPad mini 7 isn't a monumental leap forward; if we're honest, three years on from the launch of the last model we might have hoped for a more ambitious update. But the changes it does introduce are all for the better, and the base storage has been doubled too, from 64GB to a much more comfortable 128GB – while the price remains the same. Factor in Apple Intelligence too and there's plenty to like about the iPad mini 7. If you need a big screen then the Labs-winning iPad Air 11in is a better choice, but for those who prefer a more compact companion, this smart little tablet delivers the same style and versatility in a beautifully portable form. ■

SPECS 6-core Apple A17 Pro processor; 5-core Apple GPU; 8GB RAM; 8.3in IPS screen, 1,488 x 2,266 resolution; 128GB/256GB/512GB storage; 12MP rear camera; 12MP front camera; Wi-Fi 6E; Bluetooth 5.3; USB-C 3.2 Gen 2 connector; 19.3Wh battery; iPadOS 18; 135 x 6.3 x 195mm (WDH); 293g; 1yr warranty.

VERDICT

★★★★★

Not a major update, but the speedy A17 Pro chip and supremely portable design make this a fine choice.

Tony Polanco

PRICE From $2,499 **WEB** apple.com/au

Apple MacBook Pro M4

This new M4-powered machine sets a new high bar for laptops of all kinds.

Apple's latest MacBook Pro looks and feels a lot like the 2023 model, and it comes in the same 14in and 16in formats as before. However, it brings several upgrades – including a nano-texture screen option, the new, faster M4 processor and improved battery life – that make it Apple's most compelling high-end laptop yet.

The MacBook Pro M4 looks identical to its predecessor, with an aluminium design that's easy to carry yet feels rock solid. I continue to appreciate the front lip that makes the lid easy to open, and the Touch ID button for logging in quickly – although I really wish Apple would add Face ID at this point.

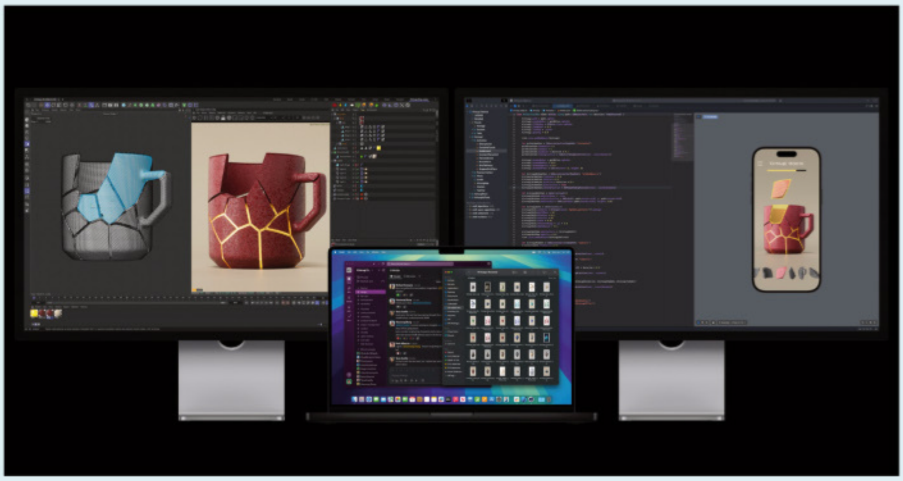
Connectivity is improved over the M3 version, with the M4 offering three Thunderbolt ports compared to last time's two. On models with a standard M4 chip these use Thunderbolt 4 for connection speeds up to 40Gbits/sec, while M4 Pro and M4 Max variants support the new Thunderbolt 5 standard, capable of going up to 120Gbits/sec.

Visuals

On the subject of the display, one major new feature of the M4 MacBook Pro is the anti-reflective nano-texture glass option. This adds $230 to the price (regardless of whether you're buying a 14in or 16in model) but it does an amazing job of cutting out glare, even in the brightest environments: you really have to see it to fully appreciate the difference it makes.

It uses the same excellent mini-LED panel as previously seen on the M3 MacBook Pro, which is visibly brighter than the screens on the older M1 and M2 models and includes an anti-reflective nano-texture glass option. In our lab tests, the MacBook Pro M4 reached a very impressive 1,527cd/m2 when displaying HDR content and 556cd/m2 with SDR, beating out any other laptop we've seen at around this price. The MacBook Pro's colour accuracy is the best in its class too, with a Delta E of just 0.19 (where zero is perfection).

It might seem like a small thing, but one of the great improvements in the M4 MacBook Pro is its webcam, which represents perhaps the biggest generational leap in visual performance I've ever seen. Where the M3 model had a merely decent 1080p camera, the new model uses a new 12MP sensor, and I



SPECS MacBook Pro 14in: M4, M4 Pro or Max chip; 16GB to 128GB unified memory; 512GB to 8TB M.2 PCI-E Gen4 SSD; 14.2in non-touch 120Hz AMOLED display, 3024 x 1964; 72Wh battery; 313 x 221 x 15.5mm (WDH); 1.6kg. **MacBook Pro 16in**: M4 Pro or M4 Max chip; 24GB to 128GB unified memory; 512GB to 8TB M.2 PCI-E Gen4 SSD; 16.2in non-touch 120Hz AMOLED display, 3456 x 2234; 100Wh battery; 356 x 248 x 16.8mm (WDH); 2.1kg. Shared: Wi-Fi 6E; Bluetooth 5; 3 x USB-C 4/Thunderbolt 5 ports (Thunderbolt 4 for M4); HDMI; SDXC card slot; 3.5mm audio; 12MP Center Stage webcam; 1yr RTB warranty.

could immediately see a huge difference in image quality when taking selfies or videoconferencing. If you regularly make video calls for work, the new MacBook Pro will help you make a professional impression.

Performance

The 2024 MacBook Pro promises all sorts of performance gains over previous models. As well as design and efficiency improvements (thanks partly to the 3nm manufacturing process), the standard M4 processor has ten CPU cores versus the M3's eight – and all models start with a roomy 16GB of RAM, optionally extendable to a maximum of 128GB on the top-spec M4 Max version.

If your daily workflow involves photo editing, you'll also be happy to know that the M4 MacBook Pro scored much higher on the PugetBench Photoshop test than competing Windows laptops, and proved nearly twice as powerful as the Intel-powered Dell XPS 13 on the Premiere Pro video test. The M4 Pro and Max variants, with up to 14 or 16 CPU cores, can be expected to do even better.

Conclusion

Apple claims that the MacBook Pro M4 can run for up to 24 hours on a full charge when streaming video (up from 22 hours in the previous generation), or 16 hours when surfing the web. In fact, in our tests it did even better than that, managing a whopping 18hrs 31mins of continuous web surfing at a screen brightness of 150cd/m2 – just over an hour longer than the M3 model.

The M3 MacBook Pro was already a fantastic laptop, and the M4 gets even closer to perfection with superb performance, a much better webcam and even longer battery life. While the screen is unchanged, the new nano-texture coating is also a great improvement that, in my view, warrants the $230 premium.

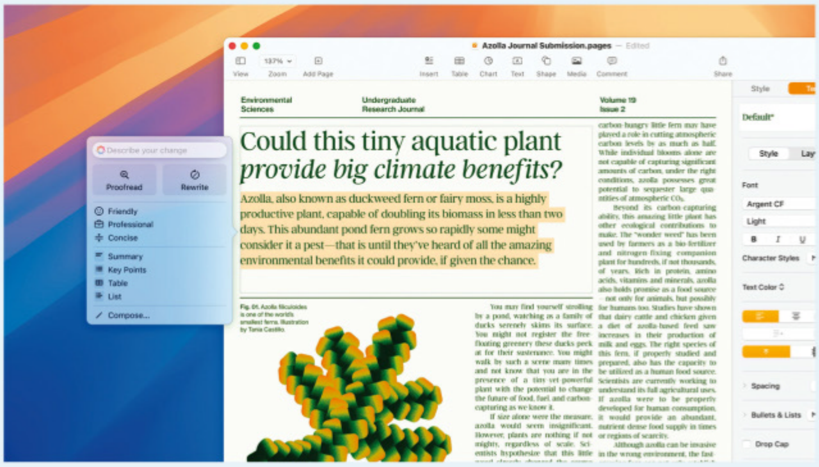
I do have a few nitpicks. I found SSD performance wasn't as great as the rest of the package, and gaming performance is merely fine. Overall, though, if I needed to buy a laptop tomorrow, it would be an M4 MacBook Pro. Even if it's overkill for my needs, I don't care: it's one of the best laptops anyone has ever produced. ■

VERDICT

★★★★★

The difficult choice isn't whether the M4 MacBook Pro is right for you, but which size and spec to choose.

Mark Spoonauer



Environmental Sciences

Undergraduate Research Journal

Volume 19
Issue 2

Could this tiny aquatic plant *provide big climate benefits?*

Azolla, also known as duckweed fern or fairy moss, is a highly productive plant, capable of doubling its biomass in less than two days. This abundant pond fern grows so rapidly some might consider it a pest—that is until they've heard of all the amazing environmental benefits it could provide, if given the chance.

Fig. 01. Azolla filiculoides is one of the world's smallest ferns. Illustration by Tania Castillo.

macOS Sequoia and Apple Intelligence

The M4 MacBook Pro comes preinstalled with macOS Sequoia, the latest version of Apple's desktop operating system, and this brings a few new features that can really enhance the experience. One I love is easy window tiling: you can just drag and drop the window you want to dock to the left side or right side of the screen and the OS snaps it into place.

Another highlight is iPhone Mirroring, which lets you view and use your iPhone directly from your Mac, even if it's in another room. I was impressed to see the connection spring up almost immediately, complete with all my apps and notifications. You can even drag photos and videos from one device to the other, if, for example, you want to create something quickly on your favourite iOS app. Other welcome updates include a new Passwords app for improved password management, new effects in messages and audio transcription in the Notes app.

Perhaps more excitingly, all Apple Silicon-powered MacBooks are in line to get the full set of Apple Intelligence features. These work with any app that lets you select text, and can quickly summarise a long note with ease, boil it down to key points, check it for errors or rewrite it to make it more professional or more engaging.

I also really like the smarter Siri, which now supports not just direct questions but follow-ups such as "how about the next 10 days" after asking about the weather. ChatGPT integration lets you take things even further: for example, I asked the assistant to generate an image of a golden retriever underneath a rainbow, and it came back with just such an image in seconds – which I was then able to add to the Photos app with a single click.

On that note, I also love the AI-powered photo clean-up tool, which did a remarkable job of removing distractions and imperfections from a portrait, while keeping the results looking realistic. There's plenty to play with in Apple Intelligence, and I look forward to finding out the ways it can make my work more fun and productive.

PRICE $2,799 **WEB** lenovo.com

Lenovo Yoga Slim 7i Aura

The latest Intel CPU in an impressive 15.3in laptop, with a couple of minor quirks.

apc EDITOR'S CHOICE

The Lenovo Yoga Slim 7i Aura is a premium slim yet powerful laptop designed to appeal to creators over competitors like the MacBook Air. It features Intel's new Core Ultra 7 258V CPU, backed up by 32GB LPDDR5x RAM, a 1TB SSD, and a delightful 15.3in 2.8K display – all in a thin laptop that weighs just 1.53kg.

While IPS rather than OLED, the Aura's display is a standout feature. The 2880 x 1800 resolution in a 15.3in form factor gives a very sharp image without being an overt drain on battery life, while the 120Hz refresh rate ensures smooth visuals when needed. The panel is rated for 100% DCI-P3 and sRGB color accuracy, and the 500-nit brightness means use outdoors is reasonably good. With a 1500:1 contrast ratio, OLED enthusiasts may yearn for slightly deeper blacks and higher brightness levels. We also love the very responsive touchscreen, but the glossy surface does increase reflectivity.

When it comes to performance, the Ultra 7 258V shines in single-core workloads, delivering snappy performance in everyday tasks like browsing, office apps, and typical multitasking. In demanding multi-threaded applications like video rendering, it lags up to 30% behind competitors like AMD's powerhouse Ryzen 9 HX 370. On the plus side, the Aura remains cool and quiet, even under prolonged heavy loads. The 258V finally offers the efficiency we have been waiting for from Intel – our video playback test clocked in at an impressive 20 hours, and it's more than capable of handling 12+ hours of office work.

The laptop includes Intel's Arc 140V graphics, offering casual gamers a capable GPU that can handle modern titles at lower settings. It's also equipped with Intel's 48 TOPS NPU that enables tools like Microsoft CoPilot+. While not yet a game-changer, it ensures some degree of future-proofing for AI-based workloads.

Connectivity options are above average for a slim device, with dual Thunderbolt 4 USB-C ports (and one on each side too), a USB-A port, HDMI 2.1, and a headphone/microphone combo jack. The inclusion of HDMI and USB-A ports is a welcome touch for those juggling modern and legacy peripherals. The side mounted power button is nice in theory, but is easy to accidentally press, and doesn't include a fingerprint reader.

The keyboard offers a top-notch typing experience with a well-spaced layout and deep travel, though the backlight could use a dimmer setting and a little glare peaks out from under the keys at low angles. The trackpad is silky smooth and accurate, though doesn't include haptic feedback. Build quality is excellent, with an aluminium body over a magnesium alloy frame that's sleek yet rigid and durable. The screen's lay-flat design adds versatility, though the lack of pen support feels like a missed opportunity.

While the overall experience is fantastic, the Yoga Slim 7i Aura has a few niggles, including Lenovo including McAfee bloatware by default. The webcam gives good results when well lit, but can be a little slow to recognize faces at a distance, and the laptops speakers, while loud with impressive bass, are a touch muddy sounding during voice calls. ■

BENCHMARK RESULTS	Lenovo Yoga Slim 7i Aura	Lenovo Yoga Slim 7x
CPU	Intel Ultra 7 258V	Snapdragon X Elite X1E-78-100
GPU	Intel Arc 140V	Qualcomm Adreno (3.8TFLOPS)
Battery Capacity	70 Wh	70Wh
RRP	$2,799	$2,909
Cinebench R24 - CPU (multi-threaded)	606	1,001
Cinebench R24 - CPU (single-threaded)	121	108
Geekbench 6 - Multi-core (score)	11,113	13,857
Geekbench 6 - Single-core (score)	2,721	2,589
Geekbench 6 - GPU (score)	28,889	20,241
CrossMark	1,796	1,301
3DMark Time Spy	4,379	1,930
3DMark Night Raid	35,878	25,001
Battery life - 1080p video playback (h:min)	20:03	23:31
CrystalDiskMark Read(MB/s)	6034	6,141
CrystalDiskMark Write (MB/s)	4215	4,474

SPECS W11 Home; Ultra 7 258V; 32GB LPDDR5x RAM; 1TB SSD; 15.3in OLED display, 2880 x 1800 pixel resolution, 100% DCI-P3 colour, 120Hz, 500-nit; 70Wh battery (20h, 3m video playback); 34.38 x 23.54 x 1.51 cm; 1.53 kg.

VERDICT

★★★★½

The Lenovo Yoga Slim 7i Aura is a sleek, versatile laptop with a great display, excellent build quality, and solid performance, and is an especially good buy when on sale for as little as AU$2,000.

Lindsay Handmer

apc
HIGHLY RECOMMENDED

PRICE $3,699 **WEB** hp.com

HP OmniBook Ultra Flip 14 (Intel)

HP's Spectre replacement is gorgeous with outstanding build quality, but it comes at a steep price.

The HP Omnibook Ultra is a more than capable laptop with a gorgeous aesthetic and enough processing power for day to day work, or even casual gaming. Our review machine has the new series 2 Intel Ultra 7 258V CPU, plus 32GB RAM, a 1TB SSD, and a 14in OLED touchscreen display. Weighing only 1.34kg, the OmniBook Ultra makes for a brilliant premium laptop, capable of being folded flat on its back to double as a tablet,or standing on its own.

The OmniBook is overly expensive at the full $3,699 RRP, though we have seen it on sale for under $2,999, which is slightly more palatable. The OmniBook Ultra Flip stands out thanks to a vibrant, bright 2880 x 1800, 120Hz OLED display and two uniquely placed, diagonally aligned USB-C ports (Thunderbolt 4 @ 40Gbps) on the back. There's an additional USB-C (10Gbps) port on the right side and a 3.5mm headphone jack on the left.

HP's on-device AI efforts are contained in the 'AI Companion' beta app that comes pre-installed, and operates independently to Microsoft Copilot. The HP chatbot is powered by the OpenAI GPT-4o model, and it can be used to quickly tweak the settings of your computer or analyse documents via typed request.

At times the many HP apps feel a little like bloatware, and the included by default McAfee should be removed right away. Initial testing of the device revealed slightly below par performance, but after disabling most of the HP management software, the results were much more promising.

Single core performance is very peppy for day-to-day use, with the OmniBook performing in line with other Ultra 7 258V equipped laptops and competitors CPUs. Multi-core performance is as expected, and only drops slightly under sustained load. Still, the Intel processor lags behind the likes of Apple's M3 and Qualcomm's Snapdragon for heavy multithreaded loads. The Intel Arc 140V graphics are excellent, and the OmniBook Ultra will appeal to those needing a machine for graphics-intensive applications.

Battery testing was a mixed bag, and while the OmniBook lasted a respectable 11 hours, 24 minutes in the PCMark 10 Office battery test, in our video playback test it only managed slightly longer at 12 hours and 37 minutes. In comparison, competitors using the same CPU and similar battery capacity (but without the 2.8K OLED) can get over 20 hours of video.

The NPU (up to 48 TOPS) occasionally offloads tasks from the GPU and CPU, such as powering blur adjustments in the 'Poly Camera Pro' app. NPU use is somewhat limited for now but we expect more applications to leverage its capabilities in the future.

A 9MP IR camera capable of facial recognition, Wi-Fi 7 and fairly rich speakers also complement the OmniBook Ultra. The keyboard is nicely sized and keys fairly weighted with deep travel, and the haptic trackpad feels quite comfortable. ■

BENCHMARK RESULTS	HP OmniBook Ultra Flip 14	Acer Swift 14 AI
CPU	Intel Ultra 7 258V	Intel Ultra 7 258V
GPU	Intel Arc 140V	Intel Arc 140V
Battery Capacity	65 Wh	65 Wh
RRP	$3699	$2,399
PCMark 10	7,490	7,193
Cinebench R24 - CPU (multi-threaded)	599	600
Cinebench R24 - CPU (single-threaded)	120	121
Geekbench 6 - Multi-core (score)	11,192	11,133
Geekbench 6 - Single-core (score)	2,696	2,731
Geekbench 6 - GPU (score)	29,537	29,188
3DMark Time Spy (score)	4,366	4,267
3DMark Night Raid (score)	35,257	36,517
Battery life - 1080p video playback (h:min)	12:37	21:43
CrystalDiskMark Read(MB/s)	7,084	5,150
CrystalDiskMark Write (MB/s)	5,208	4,662

SPECS W11 Home; 14in OLED touchscreen display, 2880 x 1800 pixel resolution, 100% DCI-P3, 400-nit; Ultra 7 258V; 32GB LPDDR5x RAM; 1TB SSD; 64Wh battery (12h 37min video playback); 31.37 x 21.62 x 1.55 cm; 1.34kg.

VERDICT

★★★★☆

A $3,699 RRP for the HP OmniBook Ultra feels exceptionally steep, but the hardware is quite premium, and it's a decent buy on special.

Zachariah Kelly

apc
EDITOR'S CHOICE

MPG
MSI PERFORMANCE GAMING
msi

PRICE $2,299 **WEB** msi.com

MSI MPG 491CQPX QD-OLED

It's big, very wide, and extremely fast.

With monitors growing in size and new panels now offering some very interesting choices, the new MSI MPG 491CQPX QD-OLED presents a very compelling option for extreme gaming. This is a 49-inch beast with stats to match its imposing size. It's functionally quite similar to Samsung's G9 Neo, which I've reviewed, but has the edge in a couple of appealing ways. Most pleasingly, it doesn't force you to use a remote like the Samsung does, and the MSI's OSD is one of the best I've ever used, being clean, sensibly arranged and well designed.

The hero stat is the fast 240Hz refresh. MSI has a similar MPG 491CQP model that tops out at 144Hz, and this is largely similar to that model in most other respects. Which is a good thing, because both are among the best gaming monitors we've ever used.

This 49-inch screen spans a 5120x1440p resolution, which isn't too imposing for the latest gen graphics cards to drive – especially with the help of frame generation. The colours on this QD OLED panel are simply amazing. If it's your first OLED monitor you just won't believe what you're seeing. A wide set of controls can tame the vivid look some may not prefer, though changing per-game is simple. Response time is 0.03ms, and I didn't detect any input lag at all while playing a series of demanding titles. HDR 400 is standard, but HRD 1000 can also be selected and the effects are extraordinary.

Owning an OLED can be a bit of a stress, with a little burn-in anxiety that never fully goes away, but MSI has included OLED Care 2.0 to reduce that risk. It runs through a self-care routine every so often, and while it can be a bit intrusive if that pops up at a bad time, it can be delayed – though not indefinitely.

It's Adaptive sync, but was detected as being G-Sync compatible on my Nvidia 4080 without the slightest bit of fuss.

On the Windows desktop, and any apps that run there, text is certainly sharp enough to call this a decent productivity monitor, though LCD still reigns supreme for crisp text. A little tweaking will let you balance the colours and brightness for optimum results here. I found the warm colour settings did induce a slight smearing of the text, but changing it on the fly for gaming (if that's what you prefer) is easy.

These and all other adjustments are made simple via the OSD, which is now accessed by a rear button right in the centre of the unit, instead of off to the side. MSI tells me this is to improve accessibility, and for most that's going to be true. I did test this monitor in my sim racing rig, and the wheel and wheel base proved to be an effective barrier to accessing the OSD button, but help is at hand with the MSI Gaming Intelligence app, which replicates every one of the OSD settings (and then some), via an onscreen app.

Another nice plus is that it can operate as a KVM switch, and it offers up a healthy 98W via USB Type C to power any devices.

This is a glorious panel built with the bells and whistles you need, and no bothersome encumbrances. Right now it's our pick for the best 49-inch screen you can buy today. ■

SPECS Screen size: 49-inch; Screen type: QD OLED; Resolution: 5120x1440; Max refresh rate: 240Hz; Colour gamut (stated): 99% P3; Inputs: 1x HDMI 2.1, 1x DisplayPort 1.4, 1x USB Type-C, USB hub, 3.5mm audio; HDR: VESA DisplayHDR: True Black 400; Features: KVM.

VERDICT

★★★★½

One of the best QD OLED panels going, with a stunning 240Hz refresh and visuals that are the best you can get right now.

Ben Mansill

LG UltraGear™ OLED

apc
HIGHLY RECOMMENDED

PRICE $2,489 **WEB** https://www.lg.com/au

LG UltraGear 39GS95QE

LG makes a big, curved, reflection-free gaming monitor. Yes, we're interested.

We've had some amazing monitors through our Labs in recent months, but a standout model was Asus' amazing, $2,300, matte-finished OLED PG32UCDP gaming monitor. Having a reflection-free OLED screen is something we've been crying out for. Now, here's LG with an 800R-curved, anti-glare, anti-reflection, 240Hz OLED rival. Could it be even better?

LG makes its UltraGear monitors in three sizes, 34, 39 and 45-inches and we reviewed the middle one… which feels massive. Construction is simple, thanks to its three-part, tool-less design and the small-footprint base provides a solid base.

Basic connectivity is covered at the rear: there are two HDMI 2.1 ports, DisplayPort 1.4, a two-port USB-A 3.0 hub and a 3.5mm audio jack. There are also some RGB flourishes but don't expect to see them if you're facing a wall. It tilts back and forth, swivels a bit both ways and is height-adjustable but LG doesn't specify by how much.

Our initial impressions weren't great. The 3440 x 1440 resolution is quite small for such a large screen and so text on a Windows Desktop looks spidery and unclear. It's also not the brightest monitor on the market and having been dazzled with high resolution super monitors lately, we were initially underwhelmed.

We had to remind ourselves it was an OLED screen. It's almost totally reflection proof. That's huge for watching content with dark scenes – and for work. It also supports HDR and, while the eye-melting brightness was missing, HDR footage still looked very impressive with details revealing themselves in both dark and bright areas, simultaneously. While some details could get lost in the brightest highlights, true-black performance was perfect and bright objects popped from the screen. Colourful transitions were smooth, but the stretched resolution meant that some monochromatic equivalents got noisy. Another issue was that fine details (like faces) could get blighted by artefacts.

I'm nitpicking, but those who want the most highly detailed, totally immersive gaming monitor might want to look elsewhere. Where this excels is in fast, general gaming performance.

The fast 240Hz refresh rate marries with the quick, OLED pixel response time to almost totally banish blurriness. The tight, 800R curve helps in various ways: it reduces eyestrain by stopping eyeballs refocussing when they pan around; it fills your peripheral vision for greater immersion; it lets you see more enemies at once; and it provides advantages like hitting apexes more easily. It really is fun to game with.

All the usual monitor settings are present and they're easily accessible and controlled by a very responsive joystick button above the base. It clearly displays what's active and scrolling between picture presets and individual adjustments gives instant, lag-free results.

Game-oriented settings include Black Stabilizer, to wreck contrast and expose enemies hiding in shadows, on-screen crosshairs and G-Sync and FreeSync Premium Pro for image-tear prevention.

Ultimately, it's not the most refined gaming monitor, but it does the important bits very well. The main problem is the price. At $2,489 it's obscenely expensive and would need to be flawless for us to recommend it. ■

SPECS 39-inch, matte, 3,440 x 1,440, HDR, 240Hz, OLED. 0.03ms GTG response time. 275-nit brightness. 1,500,000:1 contrast. 2x HDMI 2.1, 1x DisplayPort 1.4 out, 2x USB-A 3.0, 1x USB-B 3.2 upstream, 3.5mm audio jack. Tilt, Swivel and Height adjustment: Yes (unstated). 718 x 614 x 57mm, 10.4KG.

VERDICT

★★★★☆

An attractive and unique gaming monitor, but it's not perfect and it's horribly expensive.

Nick Ross

PRICE $399 **WEB** au.turtlebeach.com

Turtle Beach Stealth 700 Gen 3

The headset to get if you're a multi-platformer gamer.

apc
EDITOR'S CHOICE
TURTLE BEACH

Turtle Beach's new Stealth 700 Gen 3 gaming headset addresses my main gripe with its predecessor – the lack of compatibility across consoles. Thankfully, the third-gen Stealth 700 is truly multi-platform, with one caveat: the headset is still offered in Xbox, PlayStation and PC models, and while every version supports its chosen platform and Bluetooth-enabled devices, Series X and S support is exclusive to the Xbox version, which comes with an Xbox-specific USB dongle, as well as an additional USB dongle for everything else (including PlayStation). The Gen 3 headset will simply pair with whichever one happens to be switched on at any given time. Alternatively, there's also a dedicated button on the right ear cup which lets you switch between dongle connections.

That's not the only area in which the Stealth 700 Gen 3 has seen improvement. Battery life has effectively doubled since the Gen 2 – I've been playing *Call of Duty: Black Ops 6* multiplayer constantly since these cans arrived, about to Prestige for the second time, and Turtle Beach's Swarm II app tells me the Gen 3's battery is at 70% capacity, despite only being charged once right after their unboxing.

To my ears, the Stealth 700 Gen 3 also sounds bigger and better than its predecessor, which may be due to the jump from 50mm drivers, to 60mm drivers. Immersion is fantastic, with a wide soundstage that convincingly provides a surround sound effect, making it easy to hear approaching footsteps from enemy combatants.

As before, the Stealth 700 Gen 3 offers four sound presets – Signature Sound, Bass Boost, Bass and Treble Boost and Vocal Boost – along with the ability to create your own custom presets. Turtle Beach's Superhuman Hearing mode also returns, allowing you to dial up certain audio cues (gunshots, footsteps, etc) at the expense of a balanced audio presentation.

If there's one gaming headset feature which I consider a must-have, it's mic monitoring, and I'm pleased to say that it returns with the Stealth 700 Gen 3. I will say that my own voice doesn't sound particularly clean when relayed through the Gen 3's ear cups, but the friends I regularly play with assure me I sound quite clear. I'm also glad to see that the Gen 2's discrete flip-down mic has not changed for the Gen 3.

The Stealth 700 Gen 3 offers not one but three scroll wheels: one for volume, one which lets you adjust your game and chat balance, and another dedicated volume wheel for your Bluetooth connection – handy for when you're simultaneously connected to your smartphone for music, podcasts or even Discord.

Last but not least, the third-generation Stealth 700 headset has received a major upgrade in terms of design. Gone is the split headband from the previous model, replaced by a more seamless single-piece headband with retractable arms. It also sports sturdy metal yokes which allow the ear cups to turn on both axes, and slightly slimmer width on the ear pads, allowing for a bit more space around your ears. ■

VERDICT

★★★★½

Even if you already own the Gen 2 version, the Gen 3 is well worth the upgrade thanks to some solid build and compatibility refinements.

Stephen Lambrechts

SPECS Driver: 60mm Dual Drivers; Frequency Response: 20Hz - 20,000Hz; Battery Life: 80 hours; Connection Type: Wireless 2.4 GHz, Bluetooth 5.2 (simultaneous); Mic: Integrated Flip-to-Mute uni-directional with AI noise reduction; Weight: 408g.

SPECS 1600W rating with 6x 12V rails rated up to 50A each. ATX3.1 and PCIE 5.0 compliant. Electrical protections: OCP | OVP | OPP | OTP | UVP | SCP | NLO | SIP. Connectors: 1x ATX, 2x EPS, 10x PCI-E, 4x Molex, 2x 12VHPWR, 12x SATA, 1x Floppy. Dimensions: 210 x 150 x 86mm @ 2.5KG. 12-year warranty.

apc
EDITOR'S CHOICE

PRICE $816 **WEB** www.xpg.com/au/xpg/pc-components-fusion

XPG Fusion 1600

XPG has made a PSU that rivals the likes of Seasonic's best!

Made in partnership with Delta Electronics, the impressive Fusion 1600 is XPG's top offering. With the latest in transformer and transistor technology, the patented planar transformer and GaN FETs translate into extremely efficient switching and voltage conversion, giving this unit its 80 Plus and Cybernetics Titanium certifications. Such efficiency means less waste heat, so there's a significant dearth of heatsinks inside the unit. It runs so cool that the 135mm double ball-bearing fan won't even spin up until you're pulling around 640W to 800W. The fan curve can be tweaked via XPG's Prime app, along with monitoring voltages, temperature, and power draw.

Though marketed at gamers, the high 1600W rating of this power supply means it's really only for those seriously pushing power envelopes with overclocking or higher-end workstation builds. A lack of RGB or digital displays hammers the point home that its for serious users.

The eight electrical protection mechanisms and 12-year warranty mean this power supply should last for many system rebuilds.

Cable-wise, the girthy 3-gauge power cord hints at the amperage this unit can draw. Be mindful that this cord and the PSU utilise IEC C19/C20 plugs, not the more typical C13/C14. The rest of the twenty-one included cables cover everything you could possibly need from PCIE, 12VHPWR, to SATA and even floppy drive, and everything in between, all provided in a nice nylon bag. ■

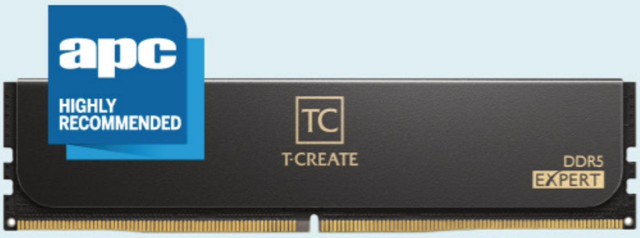
VERDICT

★★★★½

Beyond what most would ever need, this pricey but bullet proof and efficient power supply could last you a lifetime.

Mark Williams

SPECS 2x 16GB; CL30-36-36-76; PC5 48000; 1.35V; Profiles: Intel XP 3.0, AMD EXPO; Lifetime Warranty; 32(H) x 133(L) x 7(W)mm.



PRICE $199 **WEB** teamgroupinc.com

Teamgroup T-Create Expert DDR5-6000 CL30 2x16GB

A creator focused RAM kit that offers excellent performance and stability.

Thanks to steady price drops, upgrading to DDR5 RAM has been a smart move for some time now, though lower-latency kits remain hard to find. While the ideal frequency and timings depend on your needs, for AMD AM5 builds, 6000MHz CL30 offers a great mix of performance and price – though Intel users might benefit from higher frequencies.

Teamgroup's T-Create Expert DDR5 meets this demand with two-DIMM kits ranging from 32GB (two 16GB modules) to 96GB (two 48GB modules) and frequencies spanning 5600MHz to 7600MHz – and available in black or white. The 2x16GB kit we tested features CL30-36-36-76 timings, PC5-48000 bandwidth (delivering 48,000 MB/s), and runs at 1.35V. Targeted at creators rather than gamers, it skips flashy RGB LEDs to focus on stability and value – making it slightly cheaper than, for example, the same spec Teamgroup Xtreme ARGB DDR5. The T-Create Expert RAM includes a one-piece heat spreader for cooling, supports Intel XMP3.0 and AMD EXPO profiles, and comes with a lifetime warranty for added peace of mind.

The DDR5-6000 CL30 uses Hynix A-die RAM and performed flawlessly in testing, and we couldn't uncover any stability or compatibility issues. While a 6000MHz frequency with CL30 timings is ideal for AMD setups, on the newer Intel chipsets, including Z890, the RAM was easily pushed to 7000MHz without loosening timings – or happily ran lower voltages with minor tweaks.

In Australia, the 6000MHz CL30 kit is hard to find, though higher-latency variants are more readily available. And while it's not the cheapest RAM, its performance and flexibility mean Teamgroup's T-Create Expert DDR5 is worth the hunt. ■

VERDICT

★★★★☆

Solid performance and value that hits the AMD sweet spot, but has enough headroom for Intel users to push for higher frequencies.

Lindsay Handmar

NEEDS Windows 7, 8.1, 10 or 11 **WEB** https://windirstat.net

WinDirStat 2.0.3

Drive-space analyser

WinDirStat analyses your PC's hard drive(s) to identify files and folders that are taking up a lot of space. You can then delete large and unnecessary items to free up valuable storage.

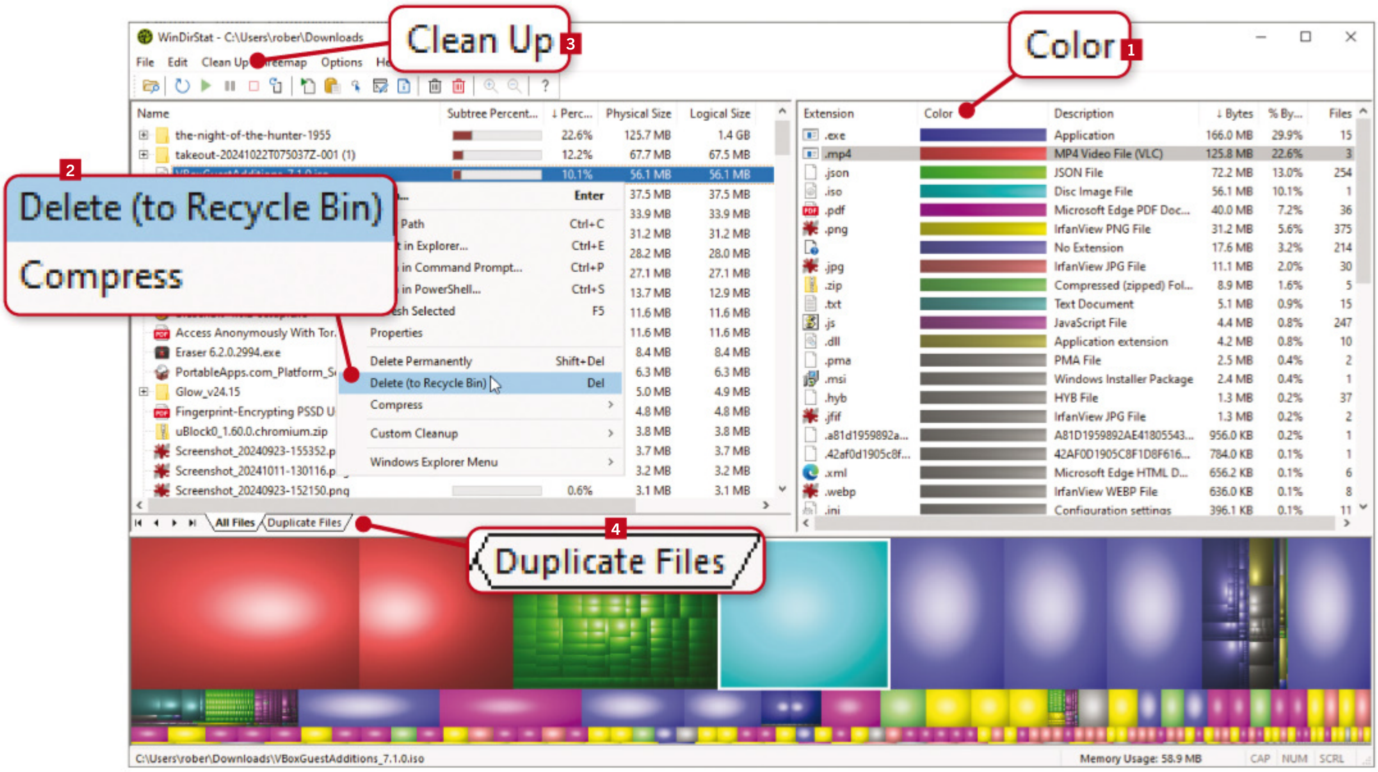
Incredibly, this is the first major new version of the program for 19 years, though there have been incremental updates in that time. Since 2013, it's been overtaken in popularity by WizTree (**https://diskanalyzer.com/**), but WinDirStat 2.0.3 should help redress the balance. It introduces lots of new features and improvements to make managing your drive space easier than ever.

When you launch WinDirStat, you can choose to scan all local drives, specific drives or partitions, or individual folders. It can even scan online-storage services such as Google Drive, OneDrive and Dropbox, provided you have the relevant desktop apps installed. Additionally, the program now lets you scan for duplicate files, by ticking that option in the Select Drives window.

Scans are now faster and more thorough, and consume less memory, especially in the new 64bit and ARM builds of WinDirStat. As before, results are displayed both as a directory list, which tells you the size of every folder in a drive and how many files it contains, and as a 'tree map', which displays space usage visually. We particularly like the Pac-Man animations that chomp back and forth while folders are being scanned, and the new ability to export scan results as a CSV spreadsheet.

WinDirStat has expanded its right-click menu with useful options for compressing large files, opening folders in PowerShell and accessing the full File Explorer right-click menu. You can also now select multiple items in the directory list, to delete lots of space hogs in one go.

Make sure you use the download links at **https://windirstat.net/download.html**, because – perhaps due to the delay in WinDirStat's development – there are several dubious sites offering fake versions of the software.



Name	Subtree Percent...	↓ Perc...	Physical Size	Logical Size
the-night-of-the-hunter-1955		22.6%	125.7 MB	1.4 GB
takeout-20241022T075037Z-001 (1)		12.2%	67.7 MB	67.5 MB
		10.1%	56.1 MB	56.1 MB
			37.5 MB	37.5 MB
			33.9 MB	33.9 MB
			31.2 MB	31.2 MB
			28.2 MB	28.0 MB
			27.1 MB	27.1 MB
			13.7 MB	12.9 MB
			11.6 MB	11.6 MB
Access Anonymously With Tor.			11.6 MB	11.6 MB
Eraser 6.2.0.2994.exe			8.4 MB	8.4 MB
PortableApps.com_Platform_S			6.3 MB	6.3 MB
Glow_v24.15			5.0 MB	4.9 MB
Fingerprint-Encrypting PSSD U			4.8 MB	4.8 MB
uBlock0_1.60.0.chromium.zip			3.8 MB	3.8 MB
Screenshot_20240923-155352.p			3.7 MB	3.7 MB
Screenshot_20241011-130116.p			3.2 MB	3.2 MB
Screenshot_20240923-152150.png		0.6%	3.1 MB	3.1 MB

Extension	Color	Description	↓ Bytes	% By...	Files
.exe		Application	166.0 MB	29.9%	15
.mp4		MP4 Video File (VLC)	125.8 MB	22.6%	3
.json		JSON File	72.2 MB	13.0%	254
.iso		Disc Image File	56.1 MB	10.1%	1
.pdf		Microsoft Edge PDF Doc...	40.0 MB	7.2%	36
.png		IrfanView PNG File	31.2 MB	5.6%	375
		No Extension	17.6 MB	3.2%	214
.jpg		IrfanView JPG File	11.1 MB	2.0%	30
.zip		Compressed (zipped) Fol...	8.9 MB	1.6%	5
.txt		Text Document	5.1 MB	0.9%	15
.js		JavaScript File	4.4 MB	0.8%	247
.dll		Application extension	4.2 MB	0.8%	10
.pma		PMA File	2.5 MB	0.4%	2
.msi		Windows Installer Package	2.4 MB	0.4%	1
.hyb		HYB File	1.3 MB	0.2%	37
.jfif		IrfanView JPG File	1.3 MB	0.2%	2
.a81d1959892a...		A81D1959892AE41805543...	956.0 KB	0.2%	1
.42af0d1905c8f...		42AF0D1905C8F1D8F616...	784.0 KB	0.1%	1
.xml		Microsoft Edge HTML D...	656.2 KB	0.1%	6
.webp		IrfanView WEBP File	636.0 KB	0.1%	8
.ini		Configuration settings	396.1 KB	0.1%	11

C:\Users\rober\Downloads\VBoxGuestAdditions_7.1.0.iso

1 WinDirStat's colour-coded tree map shows you which files are taking up the most space in the selected drive or folder. Select a colour in the top-right panel to highlight all files of that type, then click an item to view its name and size.

2 To remove a space hog, right-click it in the directory list and either delete it permanently or send it to the recycle bin. Alternatively, you can free up storage without deleting the file by choosing the new option to compress it instead.

3 After deleting large files from a hard drive or partition, you can wipe any temporary junk they've left behind. Click the Clean Up menu and select Run Windows Disk Cleanup Utility to launch Disk Cleanup directly from WinDirStat.

4 When you scan a drive for duplicate files, you can view the results by clicking the new Duplicate Files tab. Click the plus sign next to an entry to view both the original item and its copy, and right-click either one to delete the file.

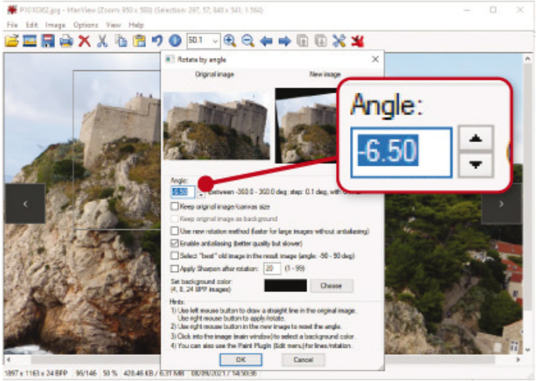
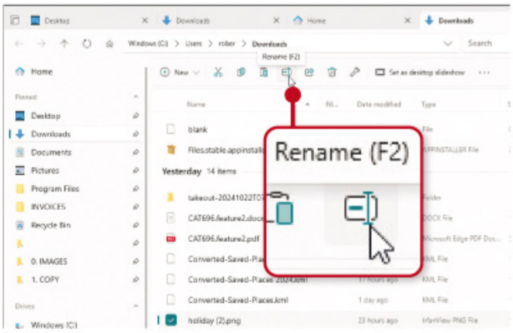


IMAGE VIEWER

IrfanView 4.7

WEB www.irfanview.coms **NEEDS** Windows 7, 8.1, 10 or 11

IrfanView 4.7 applies a host of welcome changes to the versatile free image viewer. Notable additions include the ability to rotate specific parts of a picture as well as the entire image. Select an area of the image, then click the Image menu and choose 'Custom/Fine rotation'. Click the arrow buttons next to the Angle box (see screenshot) to rotate the selection as required. IrfanView's new Browse buttons make it easier to explore all the images in a folder. To enable them, click the Options menu and select Properties/Settings followed by Browsing. Tick the 'Show browse buttons on left/right side of the main window' box and click OK. The program has also added support for EXIF data in WEBP files – simply press I to view information for images in that format.



FILE MANAGER

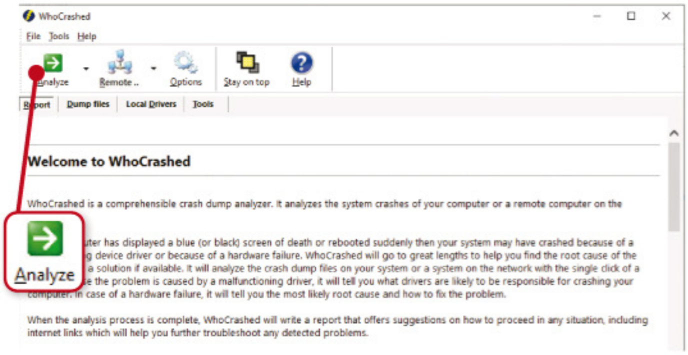
Files 3.7.11

WEB https://files.community **NEEDS** Windows 10 or 11

Our favourite free file manager has added the useful ability to rename multiple files and folders in one go. Select items by pressing Ctrl as you click them, or by ticking the boxes next to their icons. Click the Rename button on the toolbar (see screenshot) – or press F2 – to open the 'Bulk rename' box, then type the new file name and click Rename. When renaming multiple files of the same type, such as images, Files will automatically append a number to the name, for example 'holiday (2).png'. In another improvement, when you click the New button on the toolbar and choose Folder, Shortcut or one of the other options, Files now displays a confirmation message, such as 'Create new folder'. This prevents you from mistakenly creating incorrect items. As always with Files, click the 'classic installer' link on the Download page to download it for free.

Should I pay for?

Choose the right version of software



Welcome to WhoCrashed

WhoCrashed is a comprehensible crash dump analyzer. It analyzes the system crashes of your computer or a remote computer on the

uter has displayed a blue (or black) screen of death or rebooted suddenly then your system may have crashed because of a
g device driver or because of a hardware failure. WhoCrashed will go to great lengths to help you find the root cause of the
a solution if available. It will analyze the crash dump files on your system or a system on the network with the single click of a
e the problem is caused by a malfunctioning driver, it will tell you what drivers are likely to be responsible for crashing your
computer. In case of a hardware failure, it will tell you the most likely root cause and how to fix the problem.

When the analysis process is complete, WhoCrashed will write a report that offers suggestions on how to proceed in any situation, including internet links which will help you further troubleshoot any detected problems.

WhoCrashed Professional

WEB www.resplendence.com/whocrashed **PRICE** US34.95
FREE TRIAL N/A**NEEDS** Windows 7, 8.1, 10 or 11

WhoCrashed helps you work out why your PC has displayed the blue screen of death or unexpectedly shut down, by analysing 'crash dump' files to determine the cause. It's free for home use, but its Professional edition offers several extra features.

Both versions of WhoCrashed work in the same way: click the Analyze button (see screenshot) then scroll down to read the report. You can also view dump files and local drivers (which are usually responsible for crashes) by clicking the relevant tabs.

WhoCrashed Professional goes into more technical detail about crashes, but the free Home edition gives you all the information you need. This includes the time and date the crash occurred, the name of the 'module' that caused it and the error message – so you can search for further information online. However, the biggest difference in the paid-for version is that you can analyse crash reports remotely on other PCs connected to your network. It's a useful feature for system administrators in a workplace, but hardly essential for home users.

Similarly, the Professional-only setting to stop Windows deleting memory-dump files won't serve much purpose on a personal computer, where they merely take up space. And the option to analyse crash reports from the command line seems unnecessarily complicated when WhoCrashed's main interface is so easy to use.

OUR VERDICT: DON'T PAY FOR IT
WhoCrashed is an excellent program for diagnosing the causes of PC crashes, but the free Home version is all you need. Unlike many freemium tools, its Professional edition is genuinely aimed at IT professionals, with technical features you'll never use. ■

> "The biggest difference in the paid-for version is that you can analyse crash reports remotely on other PCs connected to your network. It's a useful feature for system administrators in a workplace, but hardly essential for home users."

DEVELOPER Canonical Ltd **WEB** https://ubuntu.com **LICENCE** Mainly GPL

Ubuntu 24.10

Nate Drake brims with excitement at Canonical's latest offering. Will this distro be a plumed Oriole or just plain 'Orrible?

Twenty years ago, in October 2004, the very first stable release of Ubuntu (4.10) was made available to the public.

It represented the fruits of the labour of Mark Shuttleworth and a small team of Debian developers. Since that time, with one exception, new releases of Ubuntu have been issued every six months. Version numbers correspond to the current year and month of release.

This has culminated in the latest version (24.10). In true Ubuntu tradition, it bears the alliterative code name of an animal (this time, it's Oracular Oriole).

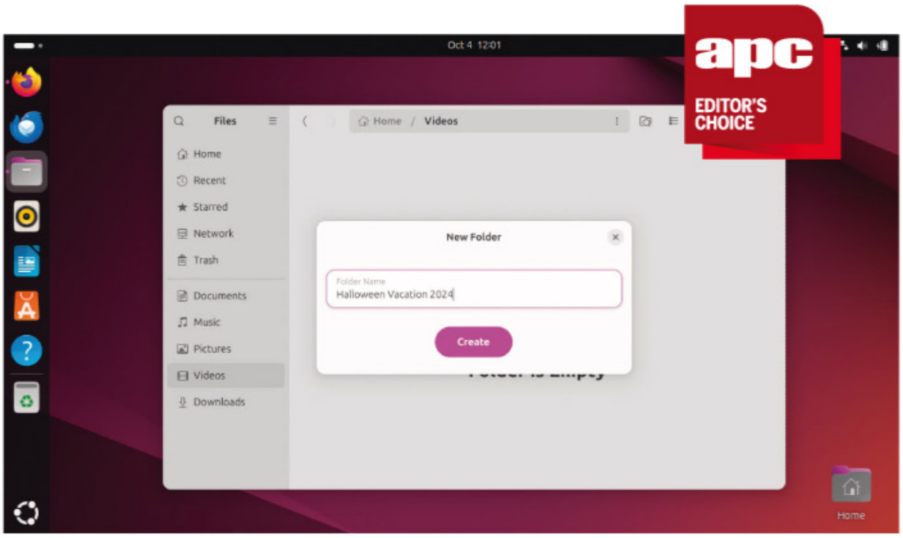
As one of the most popular Linux distros, Ubuntu supports a wide range of architectures. The AMD64 ISO is a rather weighty 6.7GB. This is around a 1GB increase over Ubuntu 24.10, which was roughly the same size as a Windows 11 ISO.

If you decide to test Ubuntu 24.10 in VirtualBox, as we did, you may see an error message on startup: vmwgfx seems to be running on an unsupported hypervisor. In our tests, we found this disappeared after installing the Guest Additions.

From going through the Flutter-based installer, there seems to be no apparent changes from the previous version of Ubuntu. Users can select their language, as well as configure accessibility options and keyboard.

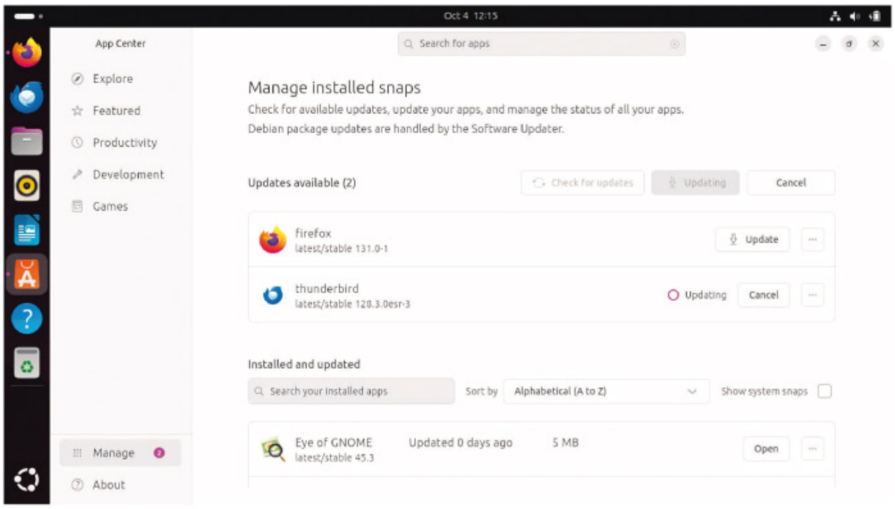
The installer also still checks whether it's up to date, and if not offers the choice to upgrade before continuing with the setup. You need to restart the installation if you choose to do this.

After opting for an automated installation, we noted that Ubuntu's setup also still offers a choice between the Default selection of apps, to include essentials such as the web browser, or the Extended selection to include additional programs, such as office tools.



Folder Name
Halloween Vacation 2024

Oracular ships with the latest Gnome 47, with support for accent colours, a customisable file manager and overhauled system dialogs.



Manage installed snaps

Check for available updates, update your apps, and manage the status of all your apps.
Debian package updates are handled by the Software Updater.

Updates available (2)

firefox latest/stable 131.0-1

thunderbird latest/stable 128.3.0esr-3 ○ Updating

Installed and updated

Sort by Alphabetical (A to Z)

Show system snaps ☐

Eye of GNOME latest/stable 45.3 Updated 0 days ago 5 MB

The Manage section of App Center now supports monitoring updates (progress is shown in the dock) and removing installed Snap packages.

The Extended option no doubt accounts for the large size of the ISO. We can't help but feel it might be more sensible to reduce the distro to the Default apps but offer to download and install others during setup if users opt for the Extended version.

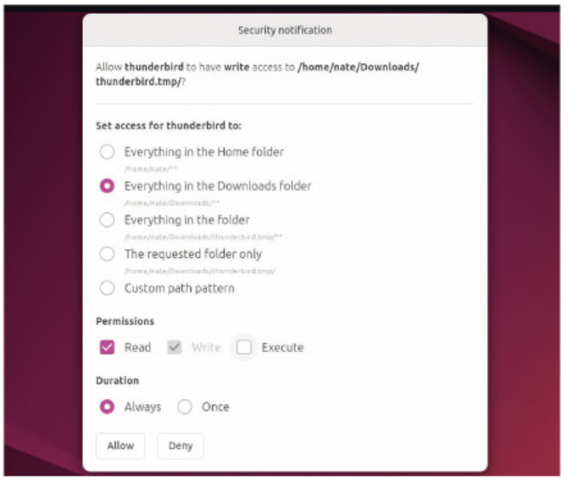
After opting for the Extended installation and creating a user account, we found that setup completed in just over 11 minutes. Upon restart, we noted that in commemoration of Ubuntu's 20th anniversary, the OS now plays the original startup sound (this can be disabled via System Settings).

The system also displayed the current release notes, which state that the system also has a default 'warty' brown accent colour.

This is significant, because Ubuntu now ships with the latest Gnome 47. Users of this desktop environment have been excitedly talking about how it now supports accent colours.

Of course, this is old hat for Ubuntu users, given the OS has supported this feature since 2022. Still, this should ensure better compatibility across third-party applications. Accent colours can be accessed in the Appearance section of System Settings. We used it to add a purple tinge to our Ubuntu desktop.

Gnome 47 has also introduced improved



Security notification

Allow **thunderbird** to have **write** access to **/home/nate/Downloads/thunderbird.tmp/**?

Set access for thunderbird to:

○ Everything in the Home folder
/home/nate/**
● Everything in the Downloads folder
/home/nate/Downloads/**
○ Everything in the folder
/home/nate/Downloads/thunderbird.tmp/**
○ The requested folder only
/home/nate/Downloads/thunderbird.tmp/
○ Custom path pattern

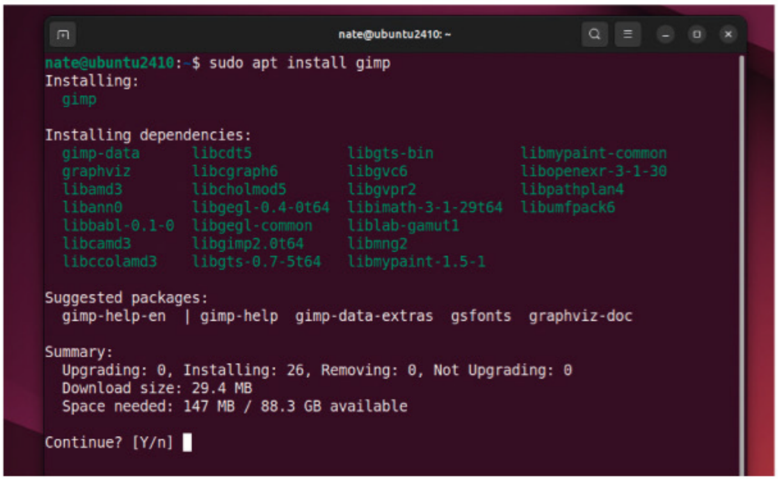
Permissions

☑ Read ☑ Write ☐ Execute

Duration

● Always ○ Once

The experimental Security Center requires you to set permissions for Snap apps. You can allow these once only or permanently.



```
nate@ubuntu2410:~$ sudo apt install gimp
Installing:
  gimp

Installing dependencies:
  gimp-data      libcdt5          libgts-bin           libmypaint-common
  graphviz       libcgraph6       libgvc6              libopenexr-3-1-30
  libamd3        libcholmod5      libgvpr2             libpathplan4
  libann0        libgegl-0.4-0t64 libimath-3-1-29t64   libumfpack6
  libbabl-0.1-0  libgegl-common   liblab-gamut1
  libcamd3       libgimp2.0t64    libmng2
  libccolamd3    libgts-0.7-5t64  libmypaint-1.5-1

Suggested packages:
  gimp-help-en  | gimp-help  gimp-data-extras  gsfonts  graphviz-doc

Summary:
  Upgrading: 0, Installing: 26, Removing: 0, Not Upgrading: 0
  Download size: 29.4 MB
  Space needed: 147 MB / 88.3 GB available

Continue? [Y/n] █
```

Ubuntu now comes with APT 3.0, which neatly displays data like package dependencies when you try to install software.

system dialogs that make use of floating buttons. They have also been overhauled to function better on narrower displays.

Other visual changes are more subtle. For instance, when you now right-click an icon in the dock, the context menu lists the application name in a header label. If the program in question is a Snap package, you can also now choose App Details to view more information in the App Center.

The App Center itself has also received some minor tweaks. Upon launch we noticed that featured Snap packages are now displayed more prominently. There's also a new Art & Design category, which includes applications such as GIMP and Blender.

The App Center's Manage section now includes information on installs in progress, and displays alerts when Snaps are running. Users can now also easily uninstall Snaps from here.

When we used the Manage section to update installed Snaps, we noticed a new quirk of the Ubuntu dock: it now displays progress bars underneath the icon of the app that's currently updating. This is a very small addition but reflects the care Ubuntu developers put into making the interface as intuitive as possible.

The App Center also now supports third-party DEB installation. This is a long-awaited feature, so we tried it out by downloading the DEB for Proton VPN. By default, DEB packages still seemed to open in File Roller. Still, when we right-clicked and chose Open With App Center, we were able to install the package without issue.

The Nautilus file manager has also been overhauled thanks to the Gnome upgrade. Crucially, users can now remove bookmarks to common folders like Documents. The Trash has now been placed at the top section.

The Gnome release notes state that all internal drives are now listed on the sidebar, as opposed to a shortcut to Other Locations, but this wasn't in our version, which we put down to the fact that it is a development release.

Gnome 47 has also slightly tweaked the Disk Usage Analyzer interface to make it visually cleaner. We fired this up to discover that our Extended install took up almost exactly 12GB on the virtual hard disk.

Another major upgrade is the inclusion of a new Security Center app. At the time of writing, there's just one experimental feature: Require Apps To Ask For System Permission. After enabling this, each time we launched a Snap app for the first time, Ubuntu served a security notification via its new prompting client. This enables you to set strict permissions to allow read or write access for specific folders. You can also set these permissions to apply only once or always. You can also choose More Options to specify a custom path, as well as assign execute permissions.

After granting Thunderbird access to the entire Downloads folder in our test machine, it launched immediately. However, the prompting client didn't appear any of the times we launched Firefox.

Command line lovers will also be pleased to discover that Oracular now ships with the latest version of APT (3.0). This is a huge improvement over the traditional wall of text that appeared in the previous version. Dependencies now appear in neat, coloured columns. APT also now displays suggested packages and a quick summary before prompting users to proceed with install.

From reading the release notes, we saw that devices using Nvidia GPUs default to Wayland sessions for the first time. Upon signing out, we noted that you can still select Ubuntu On Xorg from the login screen.

We ran System Monitor to check how well Ubuntu performs relative to the stated system specs. With only the monitor running, the system consumed around 2.5GB of RAM and 1% of our 2GHZ virtual CPU. ■

VERDICT

★★★★★

Like Tommy the Pinball Wizard, Canonical never seems to fall. The latest release is powerful, easy to set up and speedy.

Nate Drake

20 YEARS OF UBUNTU

The Ubuntu developers who released Warty Warthog in 2004 may have found it difficult to imagine that they'd be breaking out the 20th birthday candles for Ubuntu in October 2024 .

The name derives from a Bantu word, which can loosely be translated as "community spirit". This reflects Canonical's collaborative approach with the community to OS development.

For example, in 2005, the developers began the ShipIt programme, which supplied free Ubuntu CDs to anyone who requested them. It's hardly surprising that in the same year the OS won multiple awards for being the favourite distro for Linux users.

In 2023, Canonical proved Ubuntu isn't going anywhere any time soon by introducing Ubuntu Pro, which, combined with LTS releases, can extend OS support for up to 12 years. Here's to many more!

ASUS Zenbook

INTEGRATED GRAPHICS SHOOTOUT

Intel Lunar Lake takes on AMD Strix point for mobile supremacy.

Intel's Lunar Lake represents the most potent iGPU Intel has ever created, providing a decent bump over the prior generation Meteor Lake, and even taking down AMD's current top 16 CU solution.

Gaming laptops have grown in popularity over the years, but they're often heavier and noisier than models that use integrated graphics. AMD and Intel have both released new mobile processors in recent months, with beefed-up GPUs that have taken over the budget sector of the graphics market.

It's telling that we haven't seen much in the way of new budget mobile GPUs in the past few years. Nvidia still offers older Turing and Ampere-derived solutions in the MX550 and MX570, but without any of the RTX features, like DLSS and ray tracing. Those were both launched in March 2022, but if you only need that level of graphics performance, you might find that the latest iGPUs from AMD and Intel are sufficient.

We collected three similarly configured laptops and put them through a gaming test suite to see how well the latest integrated graphics solutions perform. We also ran benchmarks on a gaming laptop with a dedicated RTX 3050 Ti as a point of comparison, but there are caveats with that system that we'll cover in a moment.

Turn the page, and we'll discuss the major selling points of the latest processors and see how they stack up. – Jarred Walton

MEET THE CONTENDERS

Zenbook S16

Codenamed Strix Point, AMD's latest mobile processors come with Ryzen AI branding – the AI is for the integrated NPU and support for Copilot+, with the NPU offering up to 50 TOPS of INT8 compute. On paper, it's easy to see this as the laptop to beat, as far as gaming performance on integrated graphics goes. AMD has far more experience in the graphics arena, both with the GPU hardware and the drivers that make the GPU work.

The HX 370 processor sits close to the top of AMD's current mobile product stack, with 12 CPU cores (four Zen 5 and eight Zen 5c), and Radeon 890M graphics. There's an HX 375 as well, but the only difference is 55 TOPS from the NPU instead of 50 TOPS, and we're focused on the iGPU for this investigation.

The Radeon 890M features the RDNA 3.5 architecture, which is basically RDNA 3 plus some efficiency optimisations to improve battery life and performance. It comes with 16 Compute Units (CUs) – 33 percent more than the previous generation 780M and 680M solutions. It also clocks at up to 2,900MHz in theory, which gives it a potential 5.94 teraflops of FP32 compute. In practice, across our 24 game test suite, the 890M averaged closer to 2,000MHz, plus or minus around 200MHz, depending on the game. That drops real-world compute down to around 4.10 teraflops.

Asus's Zenbook S16 with AMD Ryzen AI 9 HX 370 comes with a larger 16-inch chassis and screen, but don't worry, we tested it with the same 28W power limit as the smaller Intel laptops.

Asus ships the Zenbook S16 with 32GB of 7500 MT/s LPDDR5x memory, which provides 120 GB/s of shared memory bandwidth. AMD officially supports up to LPDDR5x-8000 on the processor, which could potentially boost performance by another 6.7 percent, but ultimately it's up to the laptop manufacturers to decide which memory to use. All three Asus laptops we're testing also have the RAM soldered down, so there's no potential for memory upgrades down the road.

The Asus Zenbook S14 features Intel's latest Lunar Lake processor, with a 14-inch display, but faster LPDDR5x-8533 memory.

Zenbook S14

The latest laptop in our roundup is the Asus Zenbook S14, featuring Intel's Core Ultra 7 258V processor and Arc 140V graphics. Curiously, there's a supposedly faster Core Ultra 9 288V processor, but early indications are that it's underperforming – we ran some benchmarks, and in several instances the 258V outperformed the 288V. Oops. Small wonder then that there are at

> "Most ultra-thin laptops end up being power constrained, so there's limited benefit to adding even more CPU cores when the chips have to run in a 28W or lower-power envelope."

AMD STRIX HALO INCOMING?

AMD knows how to make far more powerful integrated graphics solutions than the Radeon 890M used in the Ryzen AI 9 HX 370. It's been doing so for years — look no further than the Xbox and PlayStation. The Xbox Series X packs a 52 CU GPU, while the PS5 has a 36 CU GPU — and the new PS5 Pro has a 60 CU graphics solution. So why don't we ever see anything like that for Windows PCs?

The biggest reason is economies of scale. AMD knows it will sell tens of millions of chips to Microsoft and Sony, so the cost per chip comes way down. If it were to build a similar processor for Windows PCs, would it sell? That's been a long-running debate in the PC community, but we might get a real-world answer with Strix Point Halo.

Rumours say it will feature up to 40 CUs, with a 256-bit memory interface. That second part is critical, as saddling a 40 CU graphics chip with the typical 128-bit shared memory solution of regular processors would restrict performance. Larger caches can help, but at some point, a GPU just needs more raw bandwidth.

With LPDDR5x-8000 memory, Strix Point Halo could have 256 GB/s of bandwidth, which ought to be enough to keep the 40 CUs at least moderately happy. Do note , however, that the PS5 has 448 GB/s, so AMD would need to work some magic to have such an iGPU deliver performance on par with the 32 CU RX 7600 XT or the 40 CU RX 6750 XT. But it's theoretically possible, and we're certainly curious to see how this plays out.

AMD hasn't officially said anything about Strix Point Halo, but rumours suggest we could see high-performance integrated graphics in the coming months.

The Asus Zenbook 14 OLED looks a lot like the S14, except it uses last year's Meteor Lake CPU. It also has LPDDR5x-7500 memory like the Ryzen AI laptop.

present no Core Ultra 9 288V-equipped laptops shipping, though several could show up in the coming months.

Lunar Lake processors are manufactured by TSMC using the cutting-edge N3B node for the CPU and GPU tile, with a second Platform tile that handles IO and other aspects that's fabbed on the older N6 node. These are linked together on a Foveros tile made on Intel's old 22nm FinFET process (which launched in 2012, in case you're wondering).

The Core Ultra 7 258V is the least potent of the processors we're looking at in this roundup, insofar as the CPU goes. It has just four P-cores and four E-cores, with eight cores and eight threads total. That seems like a big step backward compared to the 16 cores and 22 threads provided by the previous generation Meteor Lake processors, not to mention the 12 cores and 24 threads on tap with Ryzen AI. But there's a method to the madness.

Most ultra-thin laptops end up being power constrained, so there's limited benefit to adding even more CPU cores when the chips have to run in a 28W or lower-power envelope. Intel has beefed up the graphics solution in Lunar Lake as well, which shares power with the CPU – and the two on-package LPDDR5x chips, for that matter. The RAM uses 1.5W, we're told, so technically even though total package power was similar, Lunar Lake has a 1.5W disadvantage.

The GPU has 8 Xe2 cores (aka Battlemage) and clocks at up to 1950 MHz, for a theoretical 3.99 teraflops. It's our first encounter with Intel's second-generation Arc GPU. And don't forget the memory, which offers 136.5GB/s of bandwidth.

Zenbook 14 OLED

To see just how far Intel has – or hasn't – come in the realm of integrated graphics performance, we also have a previous-generation Meteor Lake laptop. This Asus laptop leverages the Core Ultra 7 155H, with specifications that are otherwise very similar to the newer Lunar Lake system.

The only significant difference, other than the processor, is the use of LPDDR5x-7500 memory. Keep in mind that Lunar Lake puts the memory on-package, and Intel determines what memory to use, which could explain why the newer chip gets the faster RAM.

The Core 7 155H has six P-cores with Hyper-Threading, eight E-cores, and two low-power E-cores. In application testing, it often outperforms Lunar Lake, but Lunar Lake seems more focused on efficiency, battery life, and improved AI and graphics performance than on raw CPU number crunching.

The GPU consists of the first-generation Arc Graphics (aka Alchemist), with eight Xe-cores clocking at up to 2,250 MHz. Power constraints as usual limit clock speeds in practice, and the GPU averaged around 2,000 MHz in our testing – it was basically tied with the Radeon 890M on clocks in most cases. That means up to 4.61 teraflops of compute in theory, and closer to 4.10 teraflops in practice.

Incidentally, the Lunar Lake GPU averaged around 1850 MHz in our testing for just 3.79 teraflops of compute. However, as we'll see in the performance results, architectural differences and increased memory bandwidth seem to more than make up for the deficit.

Intel's Xe2 architecture at the heart of Lunar Lake focuses on improving performance and efficiency, aiming for higher utilisation on average thanks to the SIMD16 ALUs. Geometry sees up to a 3X improvement, with twice the sampling throughput as well. Intel claims up to 1.5 times the performance of Meteor Lake at the same power, so let's see how that plays out.

WHAT ABOUT APPLE AND QUALCOMM?

You'll notice that we didn't do any testing of Apple or Qualcomm silicon. While Apple mostly rules itself out by virtue of not being able to run Windows natively, it has some serious integrated GPU performance. The M4 Pro has a 2560 shader GPU with a 256-bit memory interface that yields 273 GB/s of bandwidth, and the M4 Max doubles that to 5120 shaders and a 512-bit interface with 546 GB/s. M4 Max also offers 18.4 teraflops of compute, which puts it on par with an RTX 3070, at least on paper.

Qualcomm, for its part, has Windows on Arm support, so it does better at running games. The Snapdragon X Elite has a 12-core GPU that delivers 4.6 teraflops of performance. That seems to be what all the major players are aiming for as a baseline these days, as AMD, Apple, Intel, and Qualcomm all have such a solution.

But Qualcomm's gaming support has been pretty hit and miss so far. Besides the need for emulating x86 on Arm, Qualcomm also has to deal with graphics drivers. If you look back at Intel's Arc journey over the past couple of years, that's basically what Qualcomm faces as far as getting its drivers and performance up to snuff. Even then, a 4.6 teraflops iGPU isn't going to set the gaming world on fire, as shown by our benchmarks here.

There are over 1,000 games that run 'perfectly' or are at least 'playable' on the X Elite, but a large percentage consist of older games and smaller indie games that aren't very demanding.

The Qualcomm X Elite made a lot of noise about having amazing performance and battery life, but the reception has been muted, with plenty of complaints and returns.

PERFORMANCE ACROSS 24 GAMES

Intel claimed that Lunar Lake could deliver 1.5 times the performance of Meteor Lake, and across an extensive test suite, that's reasonably close to our final results. Technically, Lunar Lake delivered 41 percent higher performance at 720p and 35 percent more performance at 1080p, but again, we note that it's using 1.5W less power.

Out of our test suite, there was only one game that failed to run properly with Intel's current drivers: *Star Wars Outlaws*. It completely failed on Meteor Lake, and crashed to desktop frequently on Lunar Lake. We were able to get a score at 720p, but there were rendering errors, and it clearly needs more driver work, which Intel says it's doing. We tested with versions 6130 for Meteor Lake and 6028 for Lunar Lake, and note that driver versions are not yet fully synced up (at launch, the Lunar Lake drivers were months behind, so things have improved).

The battle between AMD's Radeon 890M and Intel's Arc Graphics 140V ends up being extremely close. Lunar Lake technically gets the win, by seven percent overall, but the two iGPUs trade blows across our test suite. Several of the games were also still unplayable, even at 720p with low settings. If we ignore the three games where ray tracing was enabled, *Final Fantasy XVI* and *MechWarrior 5 Clans*

GAMES PERFORMANCE TESTING RESULTS

	Core Ultra 7 258V	Ryzen AI 9 HX 370	Core Ultra 7 155H
27 Test Geomean	48 / 31	45 / 29	34 / 23
Assassin's Creed Mirage (Low)	76 / 55	85 / 56	44 / 34
Avatar: Frontiers of Pandora (Low)	33 / 20	34 / 21	17 / 12
A Plague Tale: Requiem (Medium)	29 / 20	41 / 23	29 / 20
Black Myth: Wukong (Medium)	43 / 19	39 / 24	28 / 18
Baldur's Gate 3 (Medium)	48 / 32	49 / 35	34 / 26
Control (Medium)	79 / 44	65 / 34	62 / 30
Control (RT Medium)	45 / 23	39 / 21	39 / 22
Cyberpunk 2077 (Medium)	50 / 35	48 / 29	39 / 27
Cyberpunk 2077 (RT Medium)	21 / 10	10 / 5	17 / 10
Dragon's Dogma 2 (Low)	33 / 26	37 / 30	24 / 19
Diablo IV (Medium)	87 / 62	82 / 53	72 / 49
Dying Light 2: Stay Human (Medium)	62 / 44	54 / 33	42 / 30
F1 24 (Medium)	100 / 78	119 / 86	71 / 58
Final Fantasy XVI (Low)	24 / 15	23 / 14	18 / 12
Flight Simulator (Medium)	59 / 34	51 / 34	45 / 27
God of War: Ragnarök (Low)	42 / 32	29 / 22	20 / 16
Hogwarts Legacy (Low)	70 / 43	55 / 39	40 / 29
Horizon Forbidden West (Medium)	42 / 33	38 / 35	35 / 27
MechWarrior 5 Clans (Low)	34 / 21	28 / 18	23 / 16
Spider-Man: Miles Morales (Medium)	74 / 56	66 / 48	54 / 37
Minecraft (50 Chunks)	152 / 148	143 / 113	106 / 92
Minecraft (8 RT Chunks)	35 / 17	27 / 13	30 / 16
Star Wars: Outlaws (Low)	27 / FAIL	32 / 21	FAIL / FAIL
Starfield (Low)	33 / 24	33 / 24	17 / 13
The Last of Us, Part 1 (Low)	41 / 28	48 / 30	35 / 25
Warhammer 40,000: Space Marine 2 (Low)	45 / 29	44 / 31	35 / 25
Witchfire (Medium)	55 / 35	62 / 40	44 / 30

Best scores are bolded. Testing at 720p/1080p with low or medium settings. Each laptop has 32GB of shared memory and a fast 2TB SSD. Failures proportionally scale the overall geomean, so one failure drops the overall score by 3.7% (26÷27).

are the two worst offenders.

We also mentioned comparisons with a gaming laptop with a dedicated GPU, though caveats are in order. We used a Dell G15 (5520) that's equipped with a Core i5-12500H CPU, RTX 3050 Ti GPU, and a single 8GB DDR5-4800 memory stick. Memory proved to be the worst sticking point, and The Last of Us refused to run on the laptop – we said when it was announced that the RTX 3050 Ti with 4GB of VRAM was going to be problematic, and several years later, it's really starting to age.

While there was one failure to run, overall the RTX 3050 Ti still provided 44 percent more performance than Lunar Lake at 720p, and 61 percent better performance at 1080p. A more recent GPU like the RTX 4050 would likely increase the margin of victory. But here's the important bit: the Dell laptop used a combined 115W of power across the CPU and GPU (not counting display and other components), compared to 28W for the three laptops we've focused on here.

As you can probably guess, battery life on a gaming laptop will be significantly worse than on any of these thin and light laptops. If you're looking for good battery life while playing games, you'd be far better off using a game streaming service like GeForce Now.

CONCLUSION

Laptops continue to gain market share relative to desktops, though for gaming and graphics performance, desktops still reign supreme. That's not really our point here, though. We're more interested in just how far integrated graphics have come over the past several years.

Intel used to be the worst graphics solution by far. Back when Ice Lake launched in 2019, I remember trying to test the potential gaming performance of the Core i7-1065G7. Roughly a third of the games I tried either failed to run entirely, or ran with severe rendering errors.

The Core i7-1165G7 'Tiger Lake' processor in 2020 was only moderately better, even though it was the first of the 'Xe Graphics' solutions.

Fast forward to 2024 with Arc, and we're down to just one failure out of 24 games (Star Wars Outlaws), and one other game (Baldur's Gate 3) that needs some driver tuning. (The game 'pulses' right now, with a fast-then-slow-then-fast cadence.) Perhaps more importantly, for the first time – probably ever, as far as we can recall – Intel's integrated graphics solution can legitimately lay claim to being the fastest Windows solution around. That might not last for too long, though we also question how many people are truly worried about higher iGPU performance.

Being the fastest iGPU for Windows doesn't mean Intel has the lead over every iGPU solution, of course. Apple's latest M4 chip, as an example, sports a 10-core GPU with 1,280 shader units and a theoretical 4.61 teraflops – not all that different from what we're seeing here. But the M4 Pro doubles that, and the M4 Max doubles it again. AMD isn't sitting still either, as there are credible rumblings that we could see Strix Point Halo in the coming months.

But for now? Lunar Lake has arrived, and while it doesn't win every gaming benchmark, and definitely doesn't win every CPU benchmark, overall it's currently the fastest integrated graphics solution for Windows. It's also great for battery life. Now, we just need to see what happens with future higher-wattage Intel CPUs, not to mention next year's Panther Lake. ■

GAME STREAMING VIA GEFORCE NOW

If you're thinking about getting a gaming laptop, you may want to consider grabbing a thin and light portable, and subscribing to Nvidia's GeForce Now (www.nvidia.com/en-au/geforce-now/) streaming service instead. For $10 per month, you get unlimited gaming per month in up to three-hour sessions (which you can immediately restart after reaching the limit).

You'll get roughly the cloud equivalent of an RTX 2080 or 3080, depending on the server and data centre you connect to – either of which are way faster than any of these integrated solutions. Alternatively, you can spend $27.50 per month for an RTX 4080 equivalent. The best bit is that your laptop only needs to do video decoding, which means you can legitimately stream games for hours at a time without having to plug in.

But there are also caveats, the biggest being the need for a reliable high-speed internet connection – I've tried it, and hotel internet usually isn't going to cut it, and neither will tethered cellular connections, assuming you even want to use all that data. You'd basically be using around 10GB of data per hour for a 1080p 60fps stream.

You can get a great gaming experience on a laptop via Nvidia's GeForce Now – *A Plague Tale: Requiem* runs very nicely at 1440p ultra settings, with 120fps on the Core Ultra 7 155H.

If you have good home internet with no data cap, you can sit on your couch or in your bed and play games. Except then, you're stuck trying to figure out a comfortable way to use a mouse. Move to a desk, and you're only seconds away from plugging in a power cable. But hey, $10 per month on a $1,000 laptop means it would take about five years to reach the cost of a typical modest gaming laptop with an RTX 4060.

© Pexels/Erik Dijk

A BRIEF HISTORY OF RAY TRACING

Nate Drake discovers how ray tracing was implemented in computer graphics and revolutionised art, movies, and video games.

In 1525, the German painter and engraver Albrecht Dürer pioneered a new method for creating art. It involved using a grid and a piece of string to accurately trace the movement of light from 3D surfaces onto the 2D plane of a canvas.

Dürer correctly recognised that light travels in straight lines, so the string could represent the path of light from the image to the observer's eye. The artist could then make a series of marks on the picture to represent areas of high and low contrast. This was one of the first documented 'ray tracing' techniques, whereby an artist tried to realistically portray how light interacts with objects in different ways to produce an image.

Light doesn't behave this way in the natural world. In reality, photons emanate from light sources like a lamp, then bounce off different surfaces before reaching our eyes. This creates the world we perceive around us.

Ray tracing reverses this process. It simulates the path of light by tracing the movement of rays from the viewer's eye to an object, then to any light source. It also takes into account how light rays are reflected, refracted, or absorbed by any surfaces along the way. While this method is computationally very intensive, it can create extremely realistic images and videos that capture the subtle ways that light and shadow interact in scenes.

In this guide, we'll explore how ray tracing techniques evolved from a simple grid and piece of string, to the visually stunning movies and video games we see today.

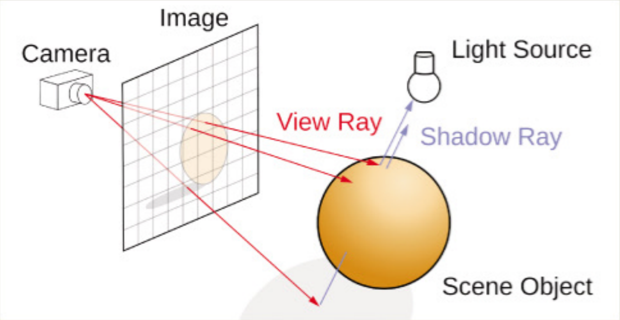
Origins

As innovative as Dürer's string and grid method was, artists' work was made easier because they only needed to render a single image onto canvas. When computer graphics first emerged in the 20th century, lighting was initially a matter of programmers manually colouring pixels as they saw fit.

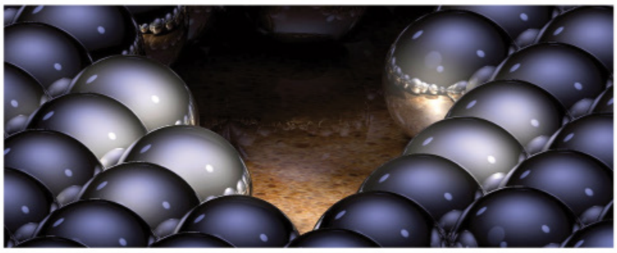
The first great leap forward for ray tracing occurred in late April 1968. IBM researcher Arthur Appel presented a paper at the spring 'Joint Computer Conference' titled 'Some techniques for shading machine renderings of solids'.

Appel acknowledged that computers had already made some gains in rendering wireframe models and other line drawings. However, he also pointed out:"Shadows, when sharply defined, tend to suggest another viewpoint and improve surface definition."

In real life, light rays can interact multiple times with different surfaces, such as reflecting off a wet sidewalk.



Ray tracing extends light rays onto a scene from the viewer's perspective, then bounces them off surfaces toward light sources.



In this image of metal spheres, up to 16 reflections are allowed per ray, so reflections of reflections can be seen.

© Wikimedia Commons, Dennis Hurd/Wikimedia Commons, Greg L/Wikimedia Commons

Appel proposed what is known today as a ray casting algorithm, though he referred to it as 'ray tracing'. This technique involved casting light rays from the viewer's eye through each pixel of an image on a plane. The intersections between light and objects in a scene could then be calculated to determine pixel colour.

In 1980, computer scientist J Turner Whitted built on work like Appel's in a paper named 'An improved illumination model for shaded display'. Despite the rather dry title, this actually represented a huge advancement: Whitted had developed the very first algorithm for 'recursive' ray tracing.

Previously, ray tracing algorithms focused on a primary ray traveling from the viewer to surfaces and light sources. Whitted's algorithm took into account secondary rays. This allowed for mirror reflection and refraction through translucent objects for the first time, with an angle determined by the solid's index of refraction. This meant ray tracing could be used for improved anti-aliasing. To showcase this concept, Whitted produced a 37-second animated film, *The Compleat Angler*. This showcased a solid sphere orbiting a translucent one.

Another good way to imagine recursive ray tracing is to think of a rainy street in a small town at night. If a computer were to render a video of this, it would need to take into account the translucent store windows, full of merchandise.

It would also need to show reflective surfaces like puddles on the sidewalk. If it's night, the light sources are likely to be street lights at fixed intervals along the road. If a recursive ray tracing algorithm was used to depict this scene, it would first cast primary rays from the viewer's 'eye' through each pixel of the image plane. These would then interact with various elements of the scene.

For instance, if a ray was to hit the wet sidewalk, the algorithm might calculate a reflection ray. This reflection ray might, in turn, hit say the store window or a street light and capture their reflections on the wet surface of the sidewalk.

The algorithm can also calculate refraction rays for translucent surfaces like store windows, allowing viewers to see objects behind the glass in a realistic way. For each intersection point, like an area of the sidewalk, shadow rays can be cast. If an object like a mailbox blocks the path to the street light, that area will be in shadow, creating realistic-looking dark areas.

Whitted's algorithm allows for multiple 'bounces' of shadow and light, so a street light might be reflected in a puddle, then a store window, then finally reach the viewer's eye. This process happens recursively for each 'bounce' of light rays until a specified, preprogrammed depth is reached. Without this limit, the computer would keep rendering the scene indefinitely.

Whitted's creation inspired a series of innovations. This included one by graphics guru Robert Cook, who pioneered distributed ray tracing. This technique, introduced in a 1984 paper, works by precisely calculating ray directions.

In Cook's own words

"By distributing the directions of the rays according to the analytic function they sample, ray tracing can incorporate fuzzy phenomena." This so-called 'fuzzy' phenomena allows for better rendering of blurred images and soft shadows, capturing nuances to better display how light interacts with real objects.

Cook and co-authors Thomas Porter and Loren Carpenter backed up their claims by producing a number of high-quality pre-rendered images to accompany the paper. However, doing so for a video was computationally infeasible. This is why distributed ray tracing wasn't immediately introduced into Pixar's 'RenderMan' software, which Cook co-authored. For example, the 1986 short film Luxo Jr was primarily rendered using traditional rasterization techniques. This was despite the film showing varying degrees of light and shadows as the lamps moved around. It wouldn't be until 1998's *A Bug's Life* that ray tracing would be used briefly for the first time in a Pixar film: to portray reflections and refractions on the surface of a bottle.

Overcoming limitations

As we've learned, the '80s laid the groundwork for the potential offered by ray tracing. However, some serious technical obstacles

11
97%
AMMO
HEALTH
2 3 4
5 6 7
ARMS
3%
ARMOR
35 / 200
11 / 50
0 / 50
0 / 300

Many '90s games used rasterisation to map objects and textures manually. Graphics cards were optimised to take advantage of this.

Battlefield V had the honor of being the first commercial video game to support real-time ray tracing.

remained to implementing it in a practical way beyond pre-rendered images and video shorts.

In 1993, Stanford researchers Eric Veach and Leonidas Guibas published a paper called 'Bidirectional Estimators for Light Transport'. This was a rather unwieldy way of describing a new ray tracing technique that traced paths from both the viewer's eye and light sources to form a single light path. This was very useful for rendering scenes with a variety of indirect lighting, such as the aforementioned wet sidewalk illuminated by streetlights.

Throughout the '90s, software such as Pixar's RenderMan started to incorporate ray tracing techniques, though the underlying hardware was still unable to deploy it in an efficient way. This is because contemporary graphics cards were optimised for rasterisation. For those readers who weren't '90s gamers, this technique was widely used in games of the era like the original *Quake*, as it struck a good balance between computational efficiency and realistic rendering.

Fundamentally, rasterisation is the process of converting 3D isometric data like polygons into 2D pixel-based images. Typically, a small number of polygons were used to represent 3D objects. This was combined with techniques like Z-buffering and texture mapping to determine the detail and visibility of polygons. Although not nearly as realistic as ray tracing, rasterisation allowed for easy scaling of graphics quality based on hardware capabilities. This was especially important in the Nineties, as there was a much wider disparity in hardware gaming performance on PCs than there is today. However, said hardware could only handle a limited number of polygons, hence the rather blocky appearance of certain games of the era, like Lara Croft in the early *Tomb Raider* games. Many titles also used in-game 'fog' so they didn't have to render distant areas until they were needed.

It wouldn't be until the new millenium that ray tracing was seriously considered for gaming. In 2002, Stanford student Tim Purcell co-authored a paper called 'Ray Tracing on Programmable Graphics Hardware'. He and his fellow researchers created a simulator that demonstrated the feasibility of deploying ray tracing on (then) next-gen GPUs more efficiently than with CPUs.

In 2009, Intel announced the prototype of its 'Larrabee' GPU that was technically capable of real-time ray tracing. Nevertheless, the technique still remained mostly in the hands of filmmakers with access to supercomputers, though even that could prove a challenge. For instance, Pixar's *Monsters Inc* (2001) took 29 hours to render just one frame of film. The company was able to pull this off in a realistic amount of time through its own 'render farm' of 2,000 computers, each with 12 cores.

When the studio began work on Monsters University in 2013, Christophe Hery, the system's core architect noted in an interview with The Verge: "We had the full campus. We had the trees, the grass, the people, the crowds, all held in memory at once. At some point, the rendering engine can try to be clever about what doesn't need to be rendered, but you can only hide so much." This was despite the fact that each render farm machine had 96GB of RAM, which left little hope for casual gamers.

Still, in August 2013, Imagination Technologies developed the Caustic Professional's R2500 and R2100 plug-in cards. These contained RT2 ray trace units (RTUs), capable of calculating up to 50 million incoherent rays per second. In 2018, it became clear that ray tracing would soon be available to the masses. This was because Nvidia partnered with Microsoft DirectX to announce the Nvidia RTX Developer Library for its 'Volta' series of GPUs. To this day, one of the easiest ways to check if your Nvidia GPU supports ray tracing is if its name includes 'RTX'.

In September the same year, Nvidia introduced the GeForce RTX and Quadro RT series of GPUs, which used its 'Turing' architecture, capable of hardware-accelerated ray tracing. This meant the GeForce RTX 2080 and 2080 Ti became the first consumer graphics cards that were capable of ray tracing in real time.

In November 2018, an update was released for EA's *Battlefield V* to make it the very first commercial video game to use Microsoft's DirectX RayTracing API. Players who had the necessary GeForce card, graphics drivers, and game update were awarded a new in-game option for 'DXR raytrace reflections quality', which could be set between 'Low' and 'Ultra' to manage reflections in surfaces like windows and water. However, this came at the expense of game frame rates.

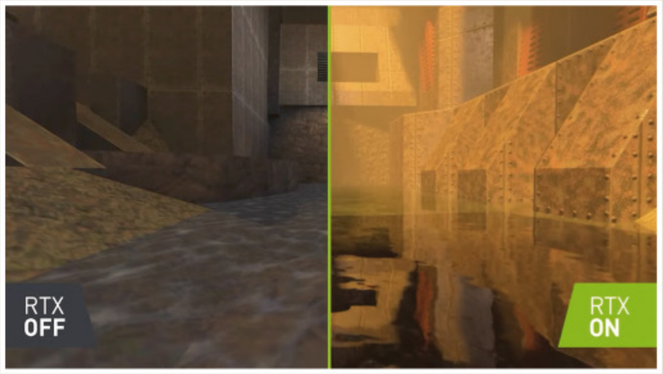
In October 2020, AMD also revealed the RX 6800, 6800 XT, and 6900 XT series of GPUs, all of which supported real-time ray tracing. The organisers of the online event weren't shy about comparing Nvidia's GPUs unfavorably with AMD's, highlighting superior performance in titles like *Battlefield V* and *Call of Duty: Modern Warfare*.

Present and future

Whether gamers were a fan of Intel or AMD, the first GPUs that supported ray tracing came with a hefty price tag. Even AMD's base RX 6800 was $1,200. In a brilliant PR move, in June 2019, Nvidia released *Quake II RTX*. This was a source port of the original 1997 shareware version of the game that fully deployed ray tracing.

The official trailer teased the game running on a Vulkan renderer, showing gameplay with and without ray tracing. This

© Freedoom Project, Battlefield YouTube Channel



Nvidia cannily bigged up ray tracing in *Quake II RTX* by displaying the game both with and without it.

The RTX version of Portal displays subtle effects like indirect light from offscreen objects. Sadly, there is still no cake.

updated version includes enhancements like real-time reflections of players and weapons on reflective surfaces like water. It also incorporated dynamic lighting for items like blinking lights.

In fairness, the game also owes its polished look to non-ray tracing aspects, like textures from the Q2XP mod-pack. Still, it's exciting to consider the possibilities ray tracing presents not just for new titles, but for giving older ones a new lease of life. Nvidia did that again in December 2020 with the release of *Minecraft* RTX, which added two new ray-traced worlds to the game.

In September 2022, Nvidia also announced the release of *Portal* (2007) with full ray tracing support. The game's former rendering APIs and system were replaced with RTX Remix's 64-bit Vulkan renderer. Fan mods also exist to simulate ray tracing effects on titles that don't have them natively, such as *Black Mesa*.

This reflects the fact that ray tracing is not supported by all current GPUs, and is demanding, even on modern hardware. It's also why many titles adopt a hybrid approach to game graphics. This usually involves combining traditional rasterisation with ray-tracing to display effects like reflections and shadows.

Cyberpunk 2077 took this approach until May 2023, when players with compatible hardware could enable full path tracing in the game's 'RT Overdrive Mode'. In theory, path tracing can offer much more realistic gameplay than ray tracing alone. For instance, it calculates not just direct light, but multiple bounces and indirect reflections from rays interacting with different surfaces. This allows for effects like 'colour bleeding', where colours from one object can reflect onto adjacent surfaces.

As light rays are scattered in many directions through path tracing, shadows can also be softer and look more natural. This has to do with how path tracing algorithms use random sampling to match real-world lighting. It's easy to imagine that everyone with compatible hardware switched to the full path-traced mode for *Cyberpunk 2077*, but this wasn't the case. Online reviewers pointed out that the performance improvement was minimal compared to the 'RT Ultra' mode. The demands on hardware, according to Nvidia, are also extreme, at 635 rays per pixel.

Game developers have tried to square this circle by implementing ray tracing in increasingly efficient ways. One good example is AI upscaling techniques like Nvidia's Deep Learning Super Sampling (DLSS) or AMD's FidelityFX Super Resolution (FSR). Both of these technologies allow games to be rendered at a lower internal resolution, then intelligently upscale footage boosting performance without sacrificing picture quality.

Looking to the future, it's very likely that ray tracing will be embraced more fully by games, but it has other useful applications. For instance, ray tracing can be used in architectural software to generate photorealistic images of videos before they're constructed. This could allow architects and their clients to get a better insight to the look and feel of the structure by taking a virtual tour, then make changes as necessary.

The main challenges that remain for ray tracing are universal adoption, as well as ensuring the feature works consistently across all modern hardware. This will become easier through using better machine learning techniques for denoising and upscaling games and videos. ■

RACKET TRACING

While ray tracing is most commonly associated with rendering realistic images and videos, its principles can also be applied to sounds. For example, in July 2024, Meta released a new audio ray tracing tool for the Meta Quest.

Ray-traced audio works by casting sound rays from sources, then tracking their paths as they bounce off surfaces. Like light, sound waves will reach the listener in various ways. This can make audio sound more real, as sound can bounce off surfaces to create realistic echoes and reverberations that match the virtual environment.

Games like *Avatar: Frontiers of Pandora* deploy the Snowdrop engine to allow dynamic occlusion. This determines how sound is perceived if there's an object in the way, such as when the player steps behind a tree when near a waterfall. Sound can also travel around or through objects in different ways – in the above example, a tree would obstruct sounds far more than a bush, which contains more gaps.

In the case of *Frontiers of Pandora*, this attempt at realism initially backfired. In an interview with Massive Entertainment, audio director Alex Riviere admitted that the combined sounds of nature would have "overwhelmed" new players. While any reader who has spent time in a real jungle will know that background noise truly can reach cacophonic levels, the developers toned it down to allow players to focus.

Another advantage of implementing sound using ray tracing is that audio can be managed by the GPU, leaving the CPU free to manage other aspects of gameplay.

© NVIDIA, NVIDIA GeForce YouTube Channel

THE RACE FOR ADVANCED ENCRYPTION

Strong encryption hasn't always been freely available to the public. **Nate Drake** tells the story of how the first Data Encryption Standard transformed the cryptography landscape.

© Thinkhubstudio /iStock / Getty Images Plus

In the introduction to his awesome treatise on the history of cryptography, *The Code Book*, Simon Singh likens the ongoing battle between those who seek to keep communications secret and the consequent efforts of others to expose them to an intellectual "arms race."

It's easy to be smug about older ciphers, such as the Caesar cipher, which simply shifts each letter in the message three places, A becoming D, B becoming E, and so on. These kinds of monoalphabetic ciphers are so easy to crack, Edgar Allan Poe even used to run a column breaking enciphered messages sent in by readers of Alexander Weekly Messenger.

The arrival of affordable computers in the '60s didn't initially herald a new wave of encryption. Secure cryptography was still the preserve of governments, though it was becoming increasingly obvious that individuals and businesses also needed to keep communications safe.

To this end, IBM set up a program to develop high-grade cryptosystems to protect its products.

This, in part, led to the implementation of DES (Data Encryption Standard), and in time AES (Advanced Encryption Standard), which we use to this day. These developments didn't happen overnight, given the competing interests of citizens and shadowy organisations like the NSA. Many cryptographers also made their careers either debunking flawed schemes or introducing ciphers of their own.

This is the story of how the first publicly available encryption algorithm, DES, came to be, as well as how ultimately it was replaced by the more secure AES.

Feistel's first steps

Horst Feistel nearly missed out on having any impact on the field of cryptography. After arriving in the USA from Berlin in 1934, he applied for American citizenship only to be placed under house arrest upon the outbreak of World War II.

Even after gaining American citizenship and studying ciphers for the likes of the US Air Force Cambridge Research Center and the Mitre Corporation in the '60s, Singh alleges that the NSA foiled Feistel's efforts so it would continue to have a monopoly on cryptographic research.

Feistel eventually landed a job at IBM's Thomas J. Watson research laboratory. Since 1966, the tech giant had decided to offer data security to its customers. This was very important to Lloyds Banking Group, which was working with IBM on the burgeoning technology of ATMs.

Clearly if financial data like a person's bank balance were sent to an ATM unencrypted, it would be easy for bad actors to monitor the connection and steal the data. Worse still, the traffic could be manipulated to have the ATM pay out cash even if the balance couldn't cover it.

Feistel began to develop an encryption algorithm using APL. The programming language limited the number of characters in a workspace name, so Feistel's DEMONSTRATION was shortened to DEMON. One colleague suggested renaming it to the more quirky Lucifer.

Lucifer represented one of the very first publicly available block ciphers. This is a type of symmetric encryption algorithm that encrypts data into fixed-size blocks (in this case 48, 32 or 128 bits). Each block of plaintext – the original message – is transformed into encrypted data using an arbitrary key. This ensures consistent encryption across the message.

In the case of Lucifer, data is encrypted according to a 'Feistel' network structure. In simplest terms, the plaintext is split into two halves. One half of this block is then processed through a mix of permutation and substitution primitives. The result is

XORed with the other half of the block. The plaintext data halves are then swapped and the process is repeated for 16 rounds.

For a more technical explanation of how Lucifer and other block ciphers work, we recommend reading Computer Security and Cryptography by Alan Konheim, a former colleague of Feistel.

There were a number of variants of Lucifer, including DTD-1, which was used in the seventies for commercial banking.

NBS vs. NSA

The National Bureau of Standards (NBS) was founded in 1901 to provide consistency for weights and measures. In 1972, members of its Institute for Computer Science & Technology (ICST) decided to further the bureau's scope by developing an algorithm that could be used to encrypt data both in transit and at rest.

One of the requirements was that the specifications of said algorithm would be public, so data security would depend only upon the secrecy of the encryption key.

This was a groundbreaking concept, given that strong encryption had previously been the purview of government agencies and the few corporations like IBM with the resources to develop their own proprietary standards.

Ruth Davis, then the director of the ICST, also asked the NSA to assess any submitted algorithms to make sure they were sufficiently secure.

There were a number of submissions but none was considered suitable until IBM submitted the Sorkin variant of Lucifer, which used 128-bit block sizes and a 128-bit encryption key.

This raised alarm with the NSA. At the time, 128-bit encryption would be all but impossible to break, so the soon-to-be-public Data Encryption Standard could be exploited by criminals or enemy states.

The NSA revised the specification to use a 64-bit encryption key. This reduced the encryption key size to 56 bits, meaning DES could be broken by state actors with access to supercomputers.

In fairness to the NSA, it also recommended making changes to Lucifer's S-boxes (substitution boxes) to make the cipher more resistant to differential cryptanalysis. This examines how differences in plaintext input affect the differences in ciphertext output, allowing an attacker to gradually reveal the key. At the time, this type of attack was known to the NSA but not the public, so the government agency was unable to explain why it had made these changes.

On March 17, 1975, the proposed DES was published in the Federal Register. Still, the NBS requested public comments and in 1976 the bureau even held two open workshops to discuss the new standard.

The NBS issued the modified version of Lucifer as Data Encryption Standard (DES) under Federal Processing Information Standard (FIPS) 46 on November 23, 1977.

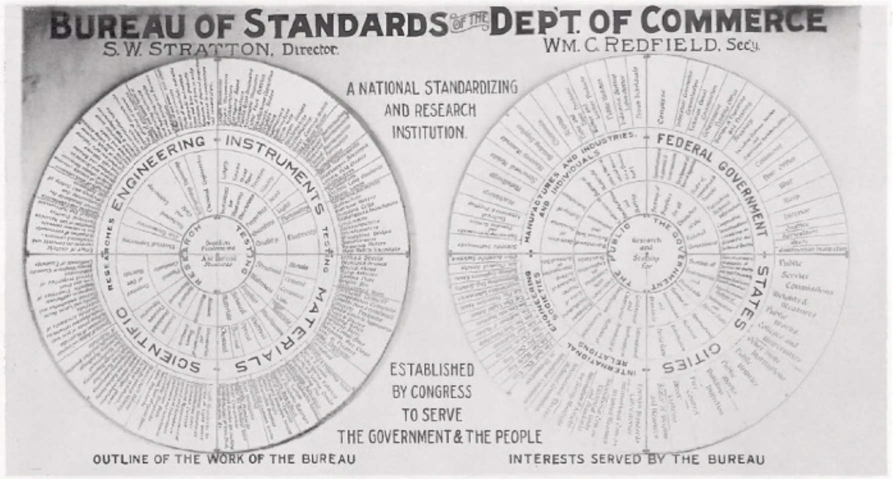
The algorithm was also adopted as an ANSI standard in 1981 and incorporated in a family of related standards for security in the US financial services industry, where it was used to secure virtually all communication and transactions.

Vetting was vilified

The fact that DES had been vetted by the NSA led to what security expert Bruce

Early ATMs were primitive but still needed a way to encrypt transactions to prevent theft.

© Getty Images/Bettmann / Contributor


BUREAU OF STANDARDS OF THE DEPT. OF COMMERCE
S. W. STRATTON, Director.
WM. C. REDFIELD, Sec'y.
A NATIONAL STANDARDIZING AND RESEARCH INSTITUTION.
ENGINEERING
INSTRUMENTS
TESTING
MATERIALS
SCIENTIFIC
RESEARCH
FEDERAL GOVERNMENT
STATES
CITIES
INTERNATIONAL RELATIONS
MANUFACTURES AND INDUSTRIES
THE PUBLIC
THE GOVERNMENT
ESTABLISHED BY CONGRESS TO SERVE THE GOVERNMENT & THE PEOPLE
OUTLINE OF THE WORK OF THE BUREAU
INTERESTS SERVED BY THE BUREAU

Although the NBS was originally designed to regulate measures, it ultimately had a huge number of interests.

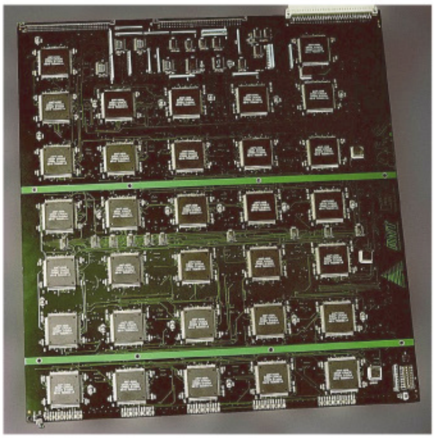
Schneier described as an “outcry among the few who paid attention.”

Among these were Stanford researchers Whitfield Diffie and Martin Hellman, who published a paper in June 1977 entitled ‘Exhaustive Cryptanalysis of the NBS Data Encryption Standard’. Diffie and Hellman tentatively called DES “too weak for some applications.” They opined that a key could be broken in 12 hours with a $20 million machine.

Admittedly, this amount of money (the equivalent of around $104 million today) would put breaking DES encryption beyond the reach of all but state actors and powerful corporations.

Still, Diffie and Hellman pointed out that in another 10 years, the cost of such a powerful computer would only be 10% of what it was then, meaning bad actors could simply store encrypted data until it became economical to decode it.

Although NSA’s changes to DES S-boxes actually strengthened its security, at the time security researchers had no way of knowing this.



The EFF’s cracking machine’s custom chips could brute force DES keys in a day.

In his seminal work Applied Cryptography, security expert Bruce Schneier quotes Alan Konheim, who played a key role in developing DES: “We sent the S-boxes off to Washington. They came back and were all different.”

However, the main concern of security researchers was DES’s vulnerability to a brute-force attack. This is a type of cryptanalytic attack that involves trying every permutation of an encryption key in the hope of hitting upon the passphrase used and reading the original message.

The time this would take depends on the number of possible encryption keys the computer can try in a given length of time. The number of possible keys for a given bit length is $2n$, where n is the key length in bits. For instance, had the NBS adopted a 128-bit encryption key version of Lucifer for DES, the number of possible keys would be 2128 or 340,282,366,920,938, 463,463,374,607,431,768,211,456.

Even assuming a supercomputer could try one trillion keys per second, this would mean brute forcing DES would have taken 10 quintillion years – far longer than the age of the current universe.

In the event, DES’s key length of 56 bits meant a limited pool of ‘only’ 72 quadrillion possible keys. This meant that by brute forcing one trillion keys a second, DES could be broken in less than a day.

Of course, in the late ’70s, even supercomputers like the Cray-1 could only manage to brute force around 1,000 DES keys per second, which may have explained why it was believed to be secure.

Even after Eli Biham and Adi Shamir independently discovered differential cryptanalysis in the late ’80s, thanks to the NSA’s modifications, they found DES to be highly resistant to this kind of attack. The theoretical weakness that they discovered to break DES faster than by brute forcing required modifications to the algorithm to make it practical.

This may explain why the NSA refuted claims that DES was inherently flawed, maintaining that it would be reviewed (and improved as necessary) every five years. Still, it reaffirmed DES as the standard in 1983, 1988 and 1993. This was despite the existence of superior encryption ciphers such as Bruce Schneier’s Blowfish, which supported key sizes of up to 448 bits.

In 1997, RSA Security decided to prove the claims of security experts such as Diffie and Hellman by announcing the DES Challenges. These were a series of competitions that offered a prize of $10,000 to whoever could break data encrypted using variable key lengths.

Even in the late ’90s, trying all possible 72 quadrillion keys on a home computer was unfeasible, so a group of computer scientists named the DESCHALL Project came up with a novel solution using internet-based infrastructure.

The team developed specialist client software to take on the task of brute forcing encryption keys. With this program, even a humble 200MHz Pentium system could test one million keys per second.

This was installed on around 78,000 computers around the world, using spare compute time to brute force. The client programs were connected to and managed by a single IBM PS/2 server, which determined which keys to try next.

With the combined efforts of all these computers, at its peak the DESCHALL Project was testing just under seven billion keys per second. The encrypted data was cracked in around three months to reveal the message: “Strong Cryptography makes the world a safer place.”

The Electronic Frontier Foundation took the project’s efforts further in July 1998 with its Deep Crack machine. At a cost of just $250,000, it used 1,856 custom microchips to crack a DES-encrypted message in 22 hours, 15 minutes. DES was now definitively and verifiably unsafe.

© Wikimedia Commons/Onderwijsgek. EFF/Wikimedia Commons

DES Descendent

The NBS, which had become the National Institute of Standards and Technology (NIST) in 1988, announced the search for a successor to DES in January 1997.

This time, NIST decided against NSA oversight. The opinions of cryptographers were sought, as the institute drafted acceptability requirements and criteria.

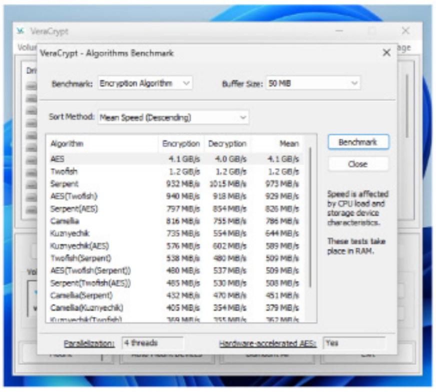
So, even before the selection process for the new encryption cipher began, NIST wanted to agree on how this would be done. By September, requests were made for candidate algorithms.

All had to support a block size of 128 bits and key lengths of 128, 192 or 256 bits. Other block sizes and key lengths could be supported if developers wished.

The institute also stressed: "AES will specify an unclassified, publicly disclosed encryption algorithm available royalty-free worldwide that is capable of protecting sensitive government information well into the next century." This was in contrast to DES, which had been made available under royalty-free patents by IBM to the US government but required licenses for use in proprietary products.

NIST made it clear that when choosing the new Advanced Encryption Standard, security would be the top priority but other factors, like efficiency, would also be considered. This was important, as while 3DES (Triple DES) increased the key length of the cipher to 112 bits by applying the algorithm three times to each block, it took substantial computing resources.

By June 15, 1998, 21 candidates had been submitted, of which 15 met the criteria. In keeping with NIST's new open approach, the algorithms were announced at the AES1 conference on August 20. The developers were also invited to provide a briefing and answer any questions.



Benchmark: Encryption Algorithm

Buffer Size: 50 MiB

Sort Method: Mean Speed (Descending)

Algorithm	Encryption	Decryption	Mean
AES	4.1 GiB/s	4.0 GiB/s	4.1 GiB/s
Twofish	1.2 GiB/s	1.2 GiB/s	1.2 GiB/s
Serpent	932 MiB/s	1015 MiB/s	973 MiB/s
AES(Twofish)	940 MiB/s	918 MiB/s	929 MiB/s
Serpent(AES)	797 MiB/s	854 MiB/s	826 MiB/s
Camellia	816 MiB/s	755 MiB/s	786 MiB/s
Kuznyechik	735 MiB/s	554 MiB/s	644 MiB/s
Kuznyechik(AES)	576 MiB/s	602 MiB/s	589 MiB/s
Twofish(Serpent)	538 MiB/s	480 MiB/s	509 MiB/s
AES(Twofish(Serpent))	480 MiB/s	537 MiB/s	509 MiB/s
Serpent(Twofish(AES))	485 MiB/s	530 MiB/s	508 MiB/s
Camellia(Serpent)	432 MiB/s	470 MiB/s	451 MiB/s
Camellia(Kuznyechik)	405 MiB/s	354 MiB/s	379 MiB/s

Speed is affected by CPU load and storage device characteristics.

These tests take place in RAM.

Parallelization: 4 threads

Hardware-accelerated AES: Yes

Modern CPUs have been optimised for Rijndael (AES), so it usually offers superior performance to other algorithms.

© Veracrypt

NIST then began the task of whittling down to the finalists. Cryptanalysis of some algorithms revealed flaws, such as LOKI97, which was found to be vulnerable to a differential analysis attack.

By the March 1999 AES2 conference, votes were taken, and in August that year, NIST announced the AES finalists: MARS, RC6, Rijndael, Serpent, and Twofish.

Intense analysis of the algorithms followed. Rijndeal, the product of Belgian cryptographers Joan Daemen and Vincent Rijmen, was a strong contender.

Using a 128-bit block size made the cipher far more secure, as large amounts of data encrypted with algorithms that use a smaller 64-bit block like DES can reveal patterns helpful to cryptanalysts.

Rijndeal's minimum key length of 128 bits would also make it computationally infeasible to break encryption using brute force methods. Also, unlike DES, Rijndeal doesn't follow a Feistel network structure. Instead, it uses a substitution-permutation network, involving multiple layers of transformations (substitutions, permutations, and mixing). This provides far better protection against differential, linear, and side-channel attacks.

Crucially, Rijndeal is also designed to run equally well on both hardware and software. This was a huge improvement on DES, which could run slowly when implemented in software.

And the winner is…

In November 2001, NIST performed what Twofish developer Bruce Schneier described as an "impossible task" and announced Rijndael as US FIPS PUB 197 (FIPS 197). The NSA proved there were no hard feelings by announcing the new AES as suitable for encrypting "Top Secret" government information.

In 2004, Schneier published a paper entitled 'The Legacy of DES'. In it he outlined the process by which DES was developed, citing the "invisible hand" of the NSA. However, he then went on to say: "But with the outcry came research. It's not an exaggeration to say that the publication of DES created the modern academic discipline of cryptography."

Certainly, the careful and transparent selection process for AES showed there were many more cryptographers both able to offer and analyse new ciphers.

While AES remains in use, we hope its successor also follows the principles of open and freely available encryption. ■

The AES Finalists

In October 2000, Bruce Schneier announced: "Of course I am disappointed that Twofish didn't win. But I have nothing but good things to say about NIST and the AES process."

This may have partly been because NIST had released a 116-page report detailing the merits of all five of the AES semi-finalists.

In the report, NIST stressed that no major security vulnerabilities had been discovered in any of the ciphers. As Schneier pointed out in his blog, Rijndael was also not considered to have the highest overall security margin. This begs the question: Why didn't each of these AES finalists make the cut?

In the case of Twofish, the cipher experienced mixed results on hardware and software for encryption/decryption of 128-bit keys, so was considered to have average speeds relative to other algorithms.

RC6 had no on-the-fly subkey computation capability for decryption. This meant it had relatively high RAM requirements, so wasn't suitable for use on devices with few hardware resources.

MARS provided excellent security but didn't perform efficiently on hardware relative to other ciphers. It also wasn't as fast as Rijndael at subkey computation.

Like Rijndael, Serpent offered excellent hardware throughput and had very low requirements, making it suitable for restricted-space environments with few resources. It also had a higher security margin than Rijndael. However, Serpent ultimately came second in the competition due to slightly less efficient software implementation.

Today, most modern processors support the AES instruction set, meaning encryption and decryption operations can be performed on the chip. This makes Rijndael considerably faster than the other AES finalists.

NEVER MISS ANOTHER SOFTWARE UPDATE

Don’t let outdated programs compromise the security and performance of your PC. Robert Irvine explains how to ensure you’re always running the latest and safest versions.

WHAT YOU CAN DO

- Detect and update all outdated software on your PC
- Automatically install the latest versions of programs
- Schedule software to update at a convenient time
- Prevent software updates from failing to install
- Download thousands of free tools without any junk
- Get notified as soon as new versions are available

Most of us are aware of the importance of keeping Windows up to date, to protect us against the latest security threats and fix newly identified bugs. This task is generally handled well by Windows Update, which means we don’t need to worry about installing updates ourselves (at least until Windows 10 support ends next October). The same applies to antivirus software, which quietly downloads new malware definitions in the background.

Sadly, many of the other programs on our PCs aren’t as efficient or reliable at updating themselves automatically. Even those that promise to check for updates don’t always install them until we choose that option. This typically entails going into the About section of the Help menu or Settings to see if a new version is available, then downloading it manually.

Outdated software poses a major security risk because hackers can exploit vulnerabilities that haven’t been patched to steal our data, infect our systems with malware and remotely take control of our PCs. Less urgently, it also means missing out on useful new tools and performance improvements.

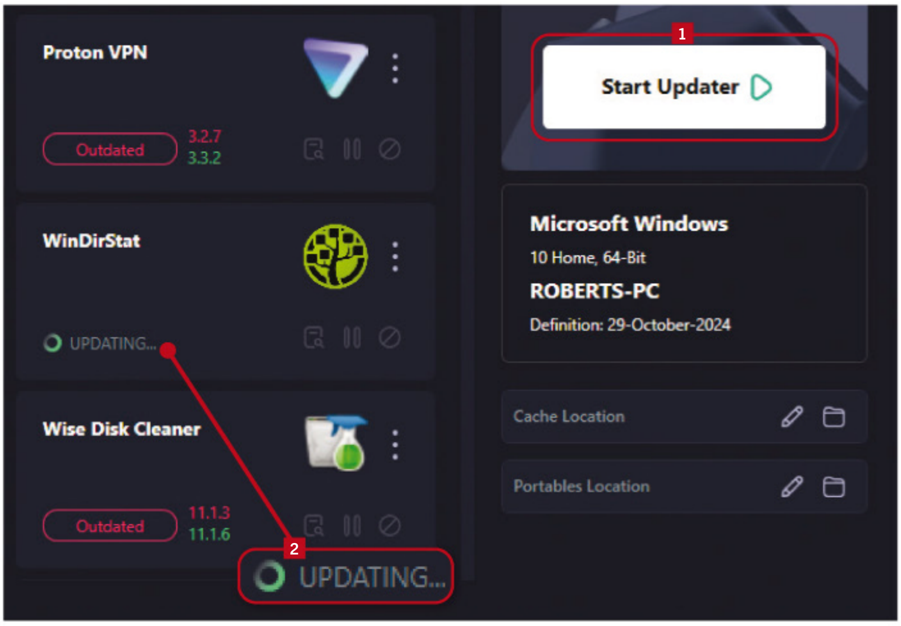
Thankfully, there are several ways to ensure you never miss an essential update again. In this feature, we reveal the best free programs that check for, download and install updates, to guarantee you’re always running the latest, fastest and safest versions of your favourite software.

UPDATE YOUR SOFTWARE USING PATCH MY PC

Patch My PC Home Updater (**www.snipca.com/52607**) has long been our favourite free software for updating other free software. With its smart, simple interface, it provides a safe and hassle-free way to install the latest versions of hundreds of popular programs.

At the end of October, Patch My PC was itself updated to version 5 – the first major release for two years. This redesigns the interface to make it even easier to use, with clearer options, a less cramped layout and an eye-friendly dark theme. It also improves the program's search tool and its detection of installed software.

Patch My PC Home Updater 5 drops the 32bit and portable editions, so is now exclusively available for 64bit Windows 10 and 11 systems. Here's how to use it to ensure you never miss another software update.


Proton VPN
Outdated
3.2.7
3.3.2
WinDirStat
UPDATING...
Wise Disk Cleaner
Outdated
11.1.3
11.1.6
2
UPDATING...
1
Start Updater
Microsoft Windows
10 Home, 64-Bit
ROBERTS-PC
Definition: 29-October-2024
Cache Location
Portables Location

You can either update outdated software individually or everything in one go.

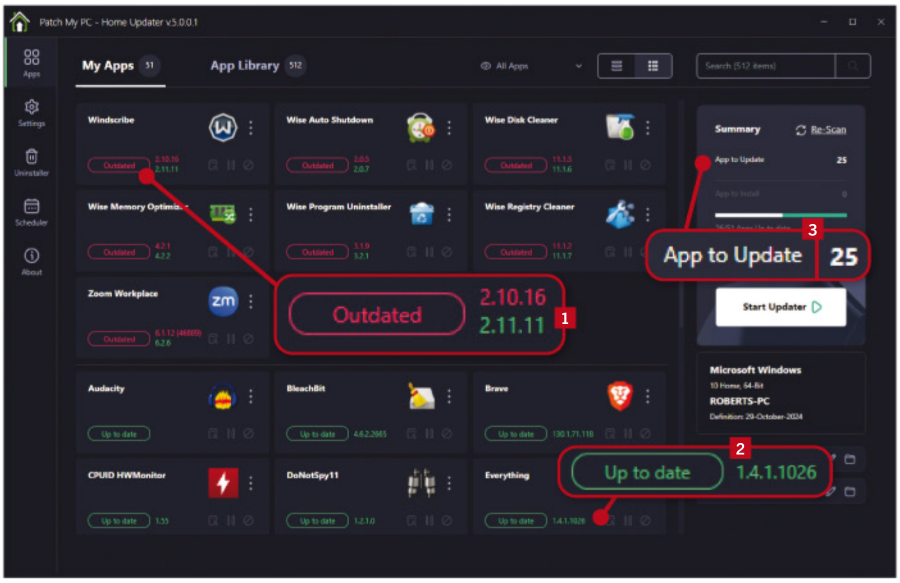
1 Scan your PC for outdated software

When you launch Patch My PC Home Updater, it will automatically scan the software you have installed on your PC to verify the version numbers. If a newer version of a program is available, it will be marked with a red 'Outdated' button (1 in our screenshot below).

All outdated software is listed alphabetically at the top of the My Apps tab, while programs running the latest versions are marked with green 'Up to date' labels and displayed below 2. The Summary panel on the right-hand side of the Apps screen tells you how many items require updating 3.

Note that Patch My PC Home Updater only checks for software from its list of more than 500 supported programs. This means it might not detect every program installed on your PC, particularly new tools and software from independent developers.

However, it covers a wide variety of popular applications, including web browsers, media players, image editors, system cleaners, office software, privacy and security tools, and much more. You can view the full list by clicking the View Supported Applications button at **www.snipca.com/52607** (about halfway down the page).


Patch My PC - Home Updater v5.0.0.1
Apps
Settings
Uninstaller
Scheduler
About
My Apps 51
App Library 512
All Apps
Search (512 items)
Windscribe
Wise Auto Shutdown
Wise Disk Cleaner
Wise Memory Optimizer
Wise Program Uninstaller
Wise Registry Cleaner
Zoom Workplace
Audacity
BleachBit
Brave
CPUID HWMonitor
DoNotSpy11
Everything
Outdated
Up to date
Summary
Re-Scan
App to Update 25
Start Updater
Microsoft Windows
10 Home, 64-Bit
ROBERTS-PC
Definition: 29-October-2024
Outdated
2.10.16
2.11.11
1
3
App to Update
25
2
Up to date
1.4.1.1026

Patch My PC Home Updater scans your PC to identify outdated software.

2 Update outdated software with one click

Patch My PC Home Updater offers two ways to manually update your outdated software. You can either click the red Outdated label for each program to update it individually or click the Start Updater button on the right (1 in our screenshot above) to update everything in one go.

You should try the first method before the second to confirm Patch My PC is working properly. It will show the new version of the software as 'Downloading' then 'Updating' 2, before moving it from the Outdated list to the 'Up to date' area below.

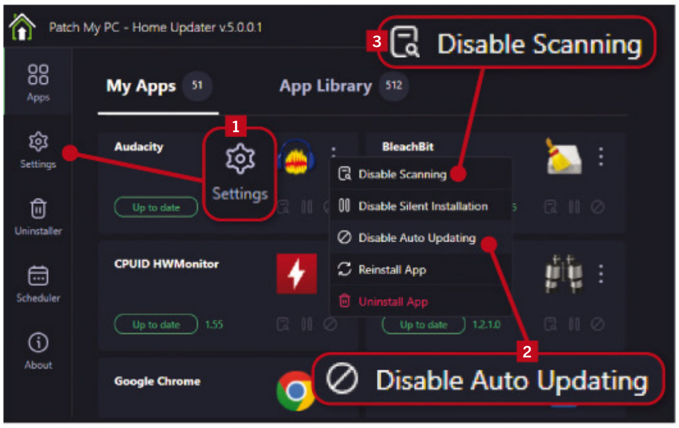
This should only take a few seconds, depending on the size of the update. You can also click several Outdated buttons to install multiple updates one after the other.

When you click the Start Updater button to 'update all', the process inevitably takes longer, with the updates shown as 'Pending' until their downloads begin. Click 'Cancel Updater' to stop the updates and perform them later or separately.

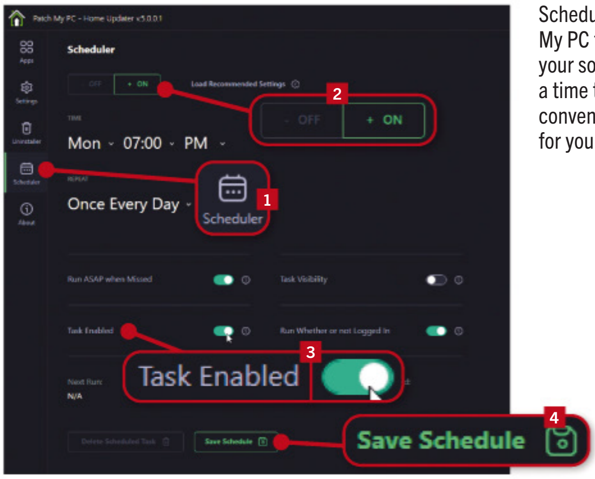
Once all updates are complete, click the Re-Scan link in the Summary box – or press F5 on your keyboard. Patch My PC should now show that all programs on your PC are up to date.

3 Control automatic software updates

Once you've updated all your software to the latest versions, Patch My PC Home


Patch My PC - Home Updater v.5.0.0.1
3 Disable Scanning
Apps
Settings
Uninstaller
Scheduler
About
My Apps 51
App Library 512
Audacity
Up to date
1 Settings
BleachBit
Disable Scanning
Disable Silent Installation
Disable Auto Updating
Reinstall App
Uninstall App
CPUID HWMonitor
Up to date 1.55
Up to date 1.2.1.0
Google Chrome
2 Disable Auto Updating

Patch My PC lets you exclude specific programs from automatic updates.


Patch My PC - Home Updater v.5.0.0.1
Apps
Settings
Uninstaller
Scheduler
About
Scheduler
OFF
+ ON
Load Recommended Settings
2
- OFF
+ ON
TIME
Mon
07:00
PM
REPEAT
Once Every Day
1 Scheduler
Run ASAP when Missed
Task Visibility
Task Enabled
Run Whether or not Logged In
Next Run:
N/A
3 Task Enabled
Delete Scheduled Task
Save Schedule
4 Save Schedule

Schedule Patch My PC to update your software at a time that's convenient for you.

Updater will automatically do so every time you launch it – so you'll never miss another important update. To ensure this function is enabled, click Settings in the left-hand toolbar (**1** in our screenshot above) and switch on the option 'When opening Patch My PC, automatically start updating outdated applications' – assuming it isn't already active.

Conversely, if you'd prefer that some programs aren't updated automatically – perhaps so you can learn about their new versions before deciding whether to install them – you can exclude them from Patch My PC's updates. On the My Apps tab, either click the Disable Auto Updating icon (which looks like a prohibition sign) on the program's tile or click its three-dot menu and choose the option there **2**. If you change your mind, click either icon again then select Enable Auto Updating.

You can also stop Patch My PC checking for new versions of specific software, by clicking the three-dot menu and choosing Disable Scanning **3**.

4 Schedule regular software updates

Rather than open Patch My PC every time you want to check for new versions of programs, you can schedule its updater to run automatically in the background. By choosing a quiet time when you're not using your computer, you'll prevent large downloads from slowing your internet connection and hogging system resources.

To set up a schedule, select Scheduler in the left-hand toolbar (**1** in our screenshot above right) and click the On button to activate the feature **2**. Click 'Load Recommended Settings' to make Patch My PC create a schedule for you – by default, this runs the updater at 7pm every day.

Alternatively, select your preferred time to check for updates, and how frequently to do so – from once a day (which will be the best option for most users) to once a year (not recommended). You can also create a one-off schedule that doesn't repeat, if you want to update software automatically while you're away or busy.

Other options let you run the updater immediately if it missed the scheduled time (because your PC was switched off), and check for updates even when you're not logged into your computer. Make sure you switch on Task Enabled **3** before you click the Save Schedule button **4**. To delete the update schedule, click the Off button then Delete Scheduled Task.

5 Install updates silently at speed

Patch My PC Home Updater offers the useful option to update software 'silently'. This means you don't need to click any confirmation prompts, select your preferred language or configure any other settings when it installs new versions.

To activate this option, click Settings and, in the Technical Options section, switch on 'Silently install and update applications' (see screenshot below left) – if it isn't already enabled. When the option is disabled, updates are more laborious because you need to click through the installers for each program.

To override silent updating for software you want to configure, click its three-dot menu on the My Apps tab and choose Disable Silent Installation. Note that some programs open confirmation prompts even during silent updates.

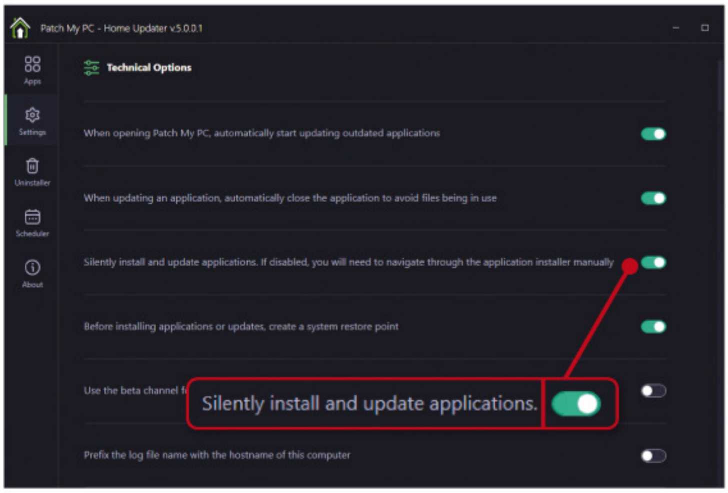
6 Prevent botched software updates

Another notable setting in the Technical Options section lets you set Patch My PC to automatically close the software it's currently updating. This ensures all files are correctly updated when it installs the latest version.

To activate this option, select 'When updating an application, automatically close the application' – or leave it disabled to stop software restarting.

You can also create a system restore point before performing updates, in the unlikely event that the new version of a program causes problems on your PC.

Install software updates silently to avoid having to click confirmation prompts.


Patch My PC - Home Updater v.5.0.0.1
Apps
Settings
Uninstaller
Scheduler
About
Technical Options
Silently install and update applications.

When opening Patch My PC, automatically start updating outdated applications

When updating an application, automatically close the application to avoid files being in use

Silently install and update applications. If disabled, you will need to navigate through the application installer manually

Before installing applications or updates, create a system restore point

Use the beta channel f

Prefix the log file name with the hostname of this computer

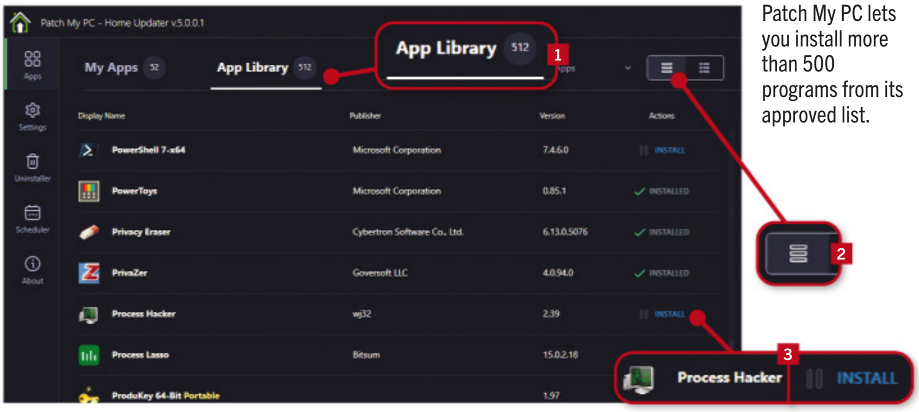
INSTALL NEW SOFTWARE USING PATCH MY PC

7 Install new software without the junk

As well as updating programs already present on your PC, Patch My PC Home Updater lets you install new ones. This saves you having to visit different developers' sites and allows you to download software quickly and safely without accidentally clicking ads. Additionally, because all programs are from Patch My PC's list of approved tools, you can be assured they don't contain malware or bundled junk.

Click the App Library tab (1 in our screenshot above right) to choose which software to install from Patch My PC's library of more than 500. To make programs easier to browse, click the three-line icon top right 2 to switch from the tiled view to an alphabetical list. You can search for specific software using the improved search tool above the Summary box.

Programs you already have installed will be labelled as such, while others have an Install button 1 you can click to get them. As with updating software, clicking multiple Install buttons will download and install selected programs one after the other.


Patch My PC - Home Updater v.5.0.0.1
Apps
Settings
Uninstaller
Scheduler
About
My Apps 52
App Library 512
App Library 512
1
2
3
Process Hacker
INSTALL

Display Name	Publisher	Version	Actions
PowerShell 7-x64	Microsoft Corporation	7.4.6.0	INSTALL
PowerToys	Microsoft Corporation	0.85.1	✓ INSTALLED
Privacy Eraser	Cybertron Software Co., Ltd.	6.13.0.5076	✓ INSTALLED
PrivaZer	Goversoft LLC	4.0.94.0	✓ INSTALLED
Process Hacker	wj32	2.39	INSTALL
Process Lasso	Bitsum	15.0.2.18	
ProduKey 64-Bit Portable		1.97	

Patch My PC lets you install more than 500 programs from its approved list.

By default, most tools are installed silently, so you shouldn't need to click anything else, though in some cases their installers will still open. If you want to configure setup options, click the Disable Silent Installation (pause button) icon before you click Install.

8 Update portable tools on a USB stick

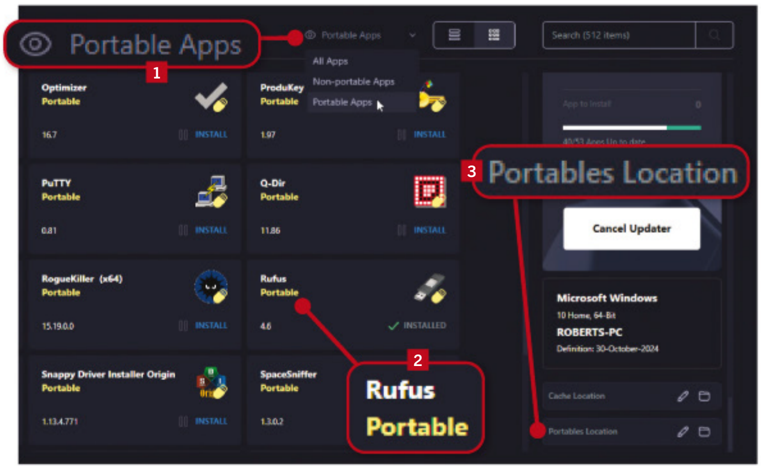
One of Patch My PC's most notable options – which you don't find in other software updaters – is the ability to update portable tools to their latest versions. Because these programs aren't actually installed on your computer, this is a particularly clever feature, but it only works for portable software you download through Patch My PC.

The updater won't detect the EXE and ZIP files of portable tools you download yourself, as it will for installable software from its approved list. Portable programs are saved to a special Portables Location folder on your PC – or a USB stick, if you prefer. This makes it easy for Patch My PC to find and update them.

To see which portable tools are available through Patch My PC, click the All Apps dropdown menu and choose Portable Apps (1 in our screenshot left). These are all labelled Portable and include Computeractive favourites such as AllDup, NirLauncher, O&O ShutUp10, Rufus 2 and Ultimate Windows Tweaker. Click the Install button to download a portable program's EXE or ZIP file to the Portables Location folder.

To change the location of this folder to a USB stick, click the pencil icon next to Portables Locations 3 in the bottom-right corner and select the relevant drive.

Patch My PC will now detect and update portable tools stored in this folder when you insert the stick into your PC.


Portable Apps
1
Portable Apps
All Apps
Non-portable Apps
Portable Apps
Search (512 items)
Optimizer
Portable
16.7
INSTALL
ProduKey
Portable
1.97
INSTALL
PuTTY
Portable
0.81
INSTALL
Q-Dir
Portable
11.86
INSTALL
RogueKiller (x64)
Portable
15.19.0.0
INSTALL
Rufus
Portable
4.6
INSTALLED
Snappy Driver Installer Origin
Portable
1.13.4.771
INSTALL
SpaceSniffer
Portable
1.3.0.2
2
Rufus
Portable
App to Install 0
40/53 Apps Up to date
3
Portables Location
Cancel Updater
Microsoft Windows
10 Home, 64-Bit
ROBERTS-PC
Definition: 30-October-2024
Cache Location
Portables Location

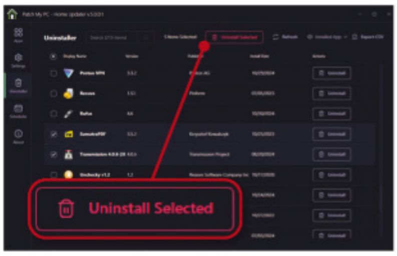
Keep portable software updated by installing it via Patch My PC.

UNINSTALL UNWANTED SOFTWARE

Patch My PC automatically uninstalls old versions of software when it replaces them with the latest ones. It also includes a dedicated uninstaller that lets you remove unwanted programs manually – and not just those from its approved library. This helps to free up space on your hard drive and make room for new software and updates.

Click 'Uninstaller' in the left-hand toolbar and select Installed Apps to view a list of software installed on your PC. You can either remove programs individually by clicking their Uninstall buttons or tick the boxes next to multiple entries and click Uninstall Selected (see screenshot).

Although the feature is quite basic – it doesn't tell you the size of programs and relies on their own uninstallers – it offers the useful option to save a list of your installed software. Click the 'Export CSV' button in the top-right corner to save the details in a spreadsheet.


Uninstaller
Uninstall Selected

SAVE THE DATE

australian
hi-fi
Show SYDNEY 2025

4-6 APRIL 2025

AT THE SYDNEY CENTRAL HOTEL

MANAGED BY ASCOTT

BROUGHT TO YOU BY WHAT HI-FI? australian hi-fi SOUND IMAGE

UPDATE SOFTWARE USING A PACKAGE MANAGER

Patch My PC Home Updater is the easiest way to update software automatically, but it limits you to the 512 programs in its approved library. To install updates for virtually any software installed on your computer, you should use a package manager.

Packages are 'pure' versions of software provided by developers, which means they don't contain any junk or malware, and let you quickly update programs to the latest versions as soon as they're available. Windows has a built-in package manager called WinGet, but this requires you to type commands into Command Prompt or PowerShell, so is far from straightforward.

A much better option is the free program UniGetUI (**www.snipca.com/52620**), which provides a graphical user interface for WinGet and other package managers. It's not as simple as Patch My PC, but it has a few advantages over that updater. Here's how to make the most of UniGetUI.

9 Update thousands of programs

UniGetUI lets you install and update thousands of Windows programs and Microsoft Store apps through its supported package managers (WinGet and Chocolatey are the main ones to use). Click its Discover Packages tab, type the name of the software and click the search button to view matching results. As long as the developer has provided a package (which most do), you should find the tool you want.

Select a program or app – or choose several – and click the 'Install selected packages' button on the toolbar. UniGetUI will then download the software to your PC, and install it using your preferred method (see next tip).

Any entries marked with a blue tick are already installed on your computer, while those with a blue up-arrow icon have new versions available. To make things easier, click the Software Updates tab (1 in our screenshot below left) to view a list of outdated programs, including their current and new version numbers.

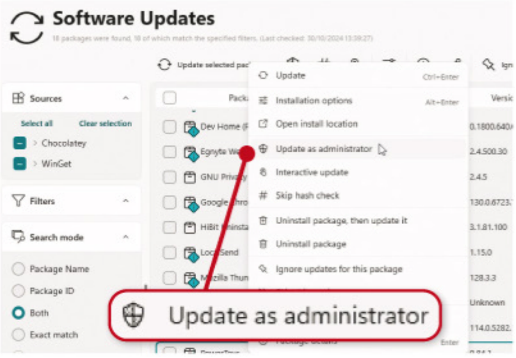
Select all the tools you want to update and click 'Update selected packages' 2 – or tick the box below this button to update them all at once. Click 'Yes' to allow UniGetUI to make changes to your device.

The progress of your software updates is shown at the bottom of the UniGetUI window, where you can cancel them if necessary.

10 Bypass update restrictions

UniGetUI gives you a wider choice of update options than Patch My PC. Right-click a program and choose between updating it as an administrator (if it requires administrator privileges), an interactive update (which displays confirmation prompts) or a standard update (to avoid clicking anything). You can also uninstall the current package before installing the new one, skip the latest release and ignore future updates.

If your software updates keep failing, choosing 'Update as administrator' (see screenshot above right) should solve the problem. To set this as the default method, click the Settings button in the bottom-left corner of the UniGetUI window and scroll down to the Package Managers section.


Software Updates
18 packages were found, 18 of which match the specified filters. (Last checked: 30/10/2024 13:39:27)
Update selected pac
Sources
Select all
Clear selection
Chocolatey
WinGet
Filters
Search mode
Package Name
Package ID
Both
Exact match
Pack
Dev Home (P
Egnyte W
GNU Priva
Google Chro
HiBit Uninsta
LocalSend
Mozilla Thun
Versio
0.1800.640
2.4.500.30
2.4.5
130.0.6723.
3.1.81.100
1.15.0
128.3.3
Unknown
114.0.5282.
Update Ctrl+Enter
Installation options Alt+Enter
Open install location
Update as administrator
Interactive update
Skip hash check
Uninstall package, then update it
Uninstall package
Ignore updates for this package
Enter
Update as administrator

Updating software as an administrator can solve installation problems.

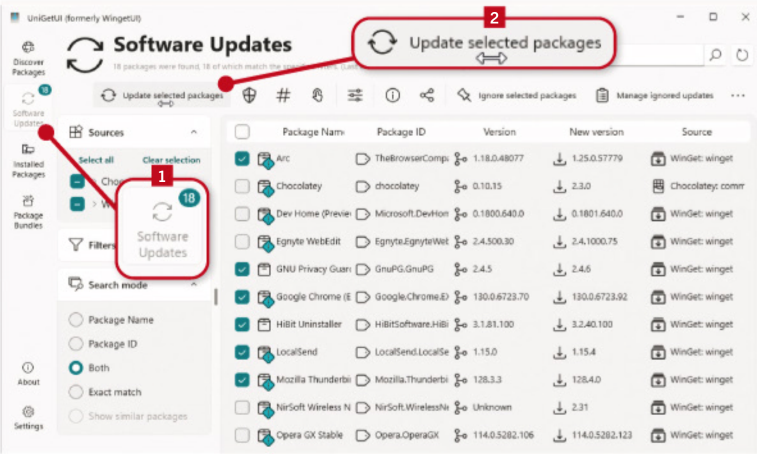
Ensure that WinGet is switched on, click the down arrow next to it and tick the box 'Always run WinGet operations with administrator rights'. Do the same for Chocolatey, then restart the program to apply the changes.

11 Get notified when updates are available

Another advantage UniGetUI has over Patch My PC is that it notifies you when new software versions are available, so you can install them immediately.

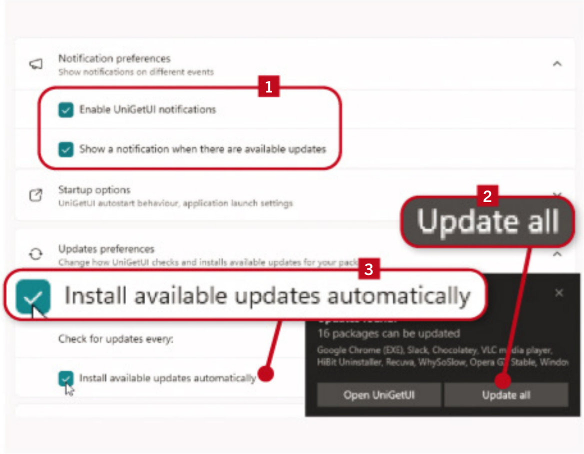
Go to Settings then 'Notification preferences' and ensure the options 'Enable UniGetUI notifications' and 'Show a notification when there are available updates' are both ticked (1 in our screenshot below). These notifications appear even when the program is closed.

Select 'Updates preferences' to specify how often UniGetUI should check for updates. You can either click the 'Update all' button in its pop-up notification 2 to install the latest updates, or save time by ticking the box to install them automatically 3.


UniGetUI (formerly WingetUI)
Discover Packages
18
Software Updates
Installed Packages
Package Bundles
About
Settings
Software Updates
18 packages were found, 18 of which match the spe
2
Update selected packages
Update selected packages
Ignore selected packages
Manage ignored updates
Sources
Select all
Clear selection
Cho
1
18
Software Updates
Filters
Search mode
Package Name
Package ID
Both
Exact match
Show similar packages

	Package Nam	Package ID	Version	New version	Source
☑	Arc	TheBrowserComp	1.18.0.48077	1.25.0.57779	WinGet: winget
☐	Chocolatey	chocolatey	0.10.15	2.3.0	Chocolatey: comm
☐	Dev Home (Previe	Microsoft.DevHon	0.1800.640.0	0.1801.640.0	WinGet: winget
☐	Egnyte WebEdit	Egnyte.EgnyteWet	2.4.500.30	2.4.1000.75	WinGet: winget
☑	GNU Privacy Guar	GnuPG.GnuPG	2.4.5	2.4.6	WinGet: winget
☑	Google Chrome (E	Google.Chrome.E	130.0.6723.70	130.0.6723.92	WinGet: winget
☑	HiBit Uninstaller	HiBitSoftware.HiBi	3.1.81.100	3.2.40.100	WinGet: winget
☑	LocalSend	LocalSend.LocalSe	1.15.0	1.15.4	WinGet: winget
☑	Mozilla Thunderbi	Mozilla.Thunderbi	128.3.3	128.4.0	WinGet: winget
☐	NirSoft Wireless N	NirSoft.WirelessN	Unknown	2.31	WinGet: winget
☐	Opera GX Stable	Opera.OperaGX	114.0.5282.106	114.0.5282.123	WinGet: winget

UniGetUI detects which installed software has updates available.


Notification preferences
Show notifications on different events
1
Startup options
UniGetUI autostart behaviour, application launch settings
2
Update all
Updates preferences
Change how UniGetUI checks and installs available updates for your pack
3
Install available updates automatically
Check for updates every:
Open UniGetUI
Update all

☑ Enable UniGetUI notifications

☑ Show a notification when there are available updates

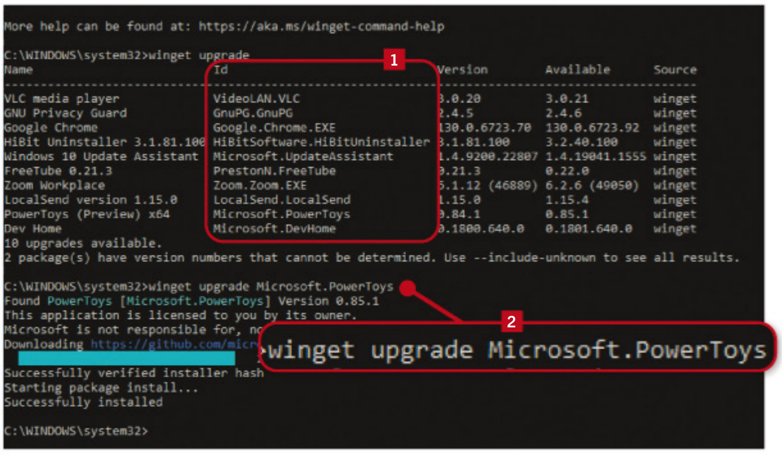
☑ Install available updates automatically

16 packages can be updated

Google Chrome (EXE), Slack, Chocolatey, VLC media player, HiBit Uninstaller, Recuva, WhySoSlow, Opera GX Stable, Windo

UniGetUI can notify you when software updates are available.

MORE WAYS TO KEEP YOUR SOFTWARE UPDATED


1
2
winget upgrade Microsoft.PowerToys

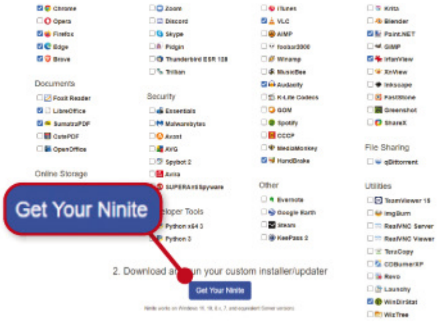
```
More help can be found at: https://aka.ms/winget-command-help

C:\WINDOWS\system32>winget upgrade
Name                          Id                              Version           Available          Source
-------------------------------------------------------------------------------------------------------------
VLC media player              VideoLAN.VLC                    3.0.20            3.0.21             winget
GNU Privacy Guard             GnuPG.GnuPG                     2.4.5             2.4.6              winget
Google Chrome                 Google.Chrome.EXE               130.0.6723.70     130.0.6723.92      winget
HiBit Uninstaller 3.1.81.100  HiBitSoftware.HiBitUninstaller  3.1.81.100        3.2.40.100         winget
Windows 10 Update Assistant   Microsoft.UpdateAssistant       1.4.9200.22807    1.4.19041.1555     winget
FreeTube 0.21.3               PrestonN.FreeTube               0.21.3            0.22.0             winget
Zoom Workplace                Zoom.Zoom.EXE                   5.1.12 (46889)    6.2.6 (49050)      winget
LocalSend version 1.15.0      LocalSend.LocalSend             1.15.0            1.15.4             winget
PowerToys (Preview) x64       Microsoft.PowerToys             0.84.1            0.85.1             winget
Dev Home                      Microsoft.DevHome               0.1800.640.0      0.1801.640.0       winget
10 upgrades available.
2 package(s) have version numbers that cannot be determined. Use --include-unknown to see all results.

C:\WINDOWS\system32>winget upgrade Microsoft.PowerToys
Found PowerToys [Microsoft.PowerToys] Version 0.85.1
This application is licensed to you by its owner.
Microsoft is not responsible for, no
Downloading https://github.com/micr

Successfully verified installer hash
Starting package install...
Successfully installed

C:\WINDOWS\system32>
```

WinGet lets you install new versions of software using Command Prompt.

12 Create a custom software updater using Ninite

The free tool Ninite (**www.snipca.com/52623**) offers a speedy way to install multiple software updates simultaneously, so you can be confident you're using the latest versions. However, it's more limited than Patch My PC Home Updater and UniGetUI, and works with a smaller selection of popular programs.

To use Ninite, you first need to create a custom installer/updater. Pick the tools you want to update from the categories on its homepage. These include web browsers such as Chrome, Firefox and Brave; media players and editors such as VLC and Audacity; image editors IrfanView and Paint.net; office software LibreOffice and SumatraPDF; and the system tools WinDirStat and WizTree.


☑ Chrome
☐ Opera
☑ Firefox
☑ Edge
☑ Brave
Documents
☐ Foxit Reader
☑ LibreOffice
☑ SumatraPDF
☐ CutePDF
☐ OpenOffice
Online Storage
☐ Zoom
☐ Discord
☐ Skype
☐ Pidgin
☐ Thunderbird ESR 128
☐ Trillian
Security
☐ Essentials
☐ Malwarebytes
☐ Avast
☐ AVG
☐ Spybot 2
☐ Avira
☐ SUPERAntiSpyware
Developer Tools
☐ Python x64 3
☐ Python 3
☐ iTunes
☑ VLC
☐ AIMP
☐ foobar2000
☐ Winamp
☐ MusicBee
☑ Audacity
☐ K-Lite Codecs
☐ GOM
☐ Spotify
☐ CCCP
☐ MediaMonkey
☑ HandBrake
Other
☐ Evernote
☐ Google Earth
☐ Steam
☐ KeePass 2
☐ Krita
☐ Blender
☑ Paint.NET
☐ GIMP
☑ IrfanView
☐ XnView
☐ Inkscape
☐ FastStone
☐ Greenshot
☐ ShareX
File Sharing
☐ qBittorrent
Utilities
☐ TeamViewer 15
☐ ImgBurn
☐ RealVNC Server
☐ RealVNC Viewer
☐ TeraCopy
☐ CDBurnerXP
☐ Revo
☐ Launchy
☑ WinDirStat
☐ WizTree
Get Your Ninite
2. Download and run your custom installer/updater
Get Your Ninite

Ninite automatically updates selected software through a custom installer.

Once you've ticked all the relevant boxes, click the Get Your Ninite button (see screenshot above) to create and download your custom installer. Run its EXE file to install your selected tools – or update them if they're already installed.

Every time you run Ninite's installer, it will check for new versions of each program and update them automatically. Ninite removes bundled junk, and selects the correct language and builds of software (32bit or 64bit) for your PC.

13 Update software from the command line

As we mentioned on the previous page, using the Windows Package Manager – better known as WinGet – to update software isn't as straightforward as using Patch My PC or UniGetUI. But this command-line tool saves you having to download and run a dedicated updater, and – once you've mastered it – provides a quick way to check for and install new versions of your favourite software.

To access WinGet, type cmd into the Windows search box and click 'Run as administrator' below Command Prompt (it also works in PowerShell). When Command Prompt opens, type winget and press Enter to see a list of WinGet commands.

If the 'winget' command isn't recognised, download the latest version of the Windows Package Manager from **www.snipca.com/52625**. If you're prompted to agree to 'all the source agreement terms', press Y (for Yes) to continue.

Next, type winget upgrade to list all software on your PC that has new versions available. To update a specific program, type winget upgrade again, followed by its 'App ID', which you'll find in the Id column (1 in our screenshot above). For example, to update PowerToys, type winget upgrade Microsoft.PowerToys 2. Winget will then download and install the latest version of that program.

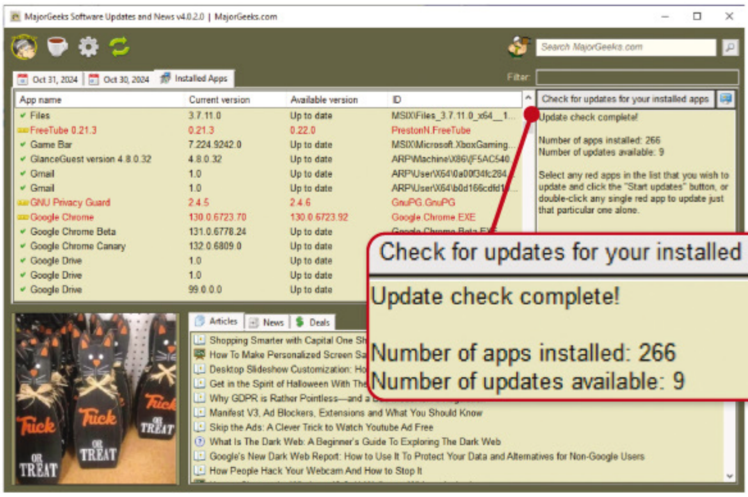
Alternatively, you can update all outdated software in one go. Typing winget upgrade --all will identify all programs with new versions available and attempt to install them.

14 Update all your software from one website

Some software-download sites provide their own updaters for installing the latest versions of programs they host. This isn't as safe as downloading 'pure' packages (because some sites bundle junk with downloads), so it's important to choose a service you can trust.

The Filepuma Update Detector (**www.snipca.com/52631**) is one of the most reliable options. It scans your PC for outdated software then opens a web page listing the results. You can then download the new version of each program directly from Filepuma. Go into the detector's Settings to specify whether it should run on Windows startup.

The excellent download site MajorGeeks.com also has a software updater (**www.snipca.com/52632**). This checks for and installs updates for a huge number of programs (see screenshot below) – including tools from small developers that other updaters miss – but it's somewhat bloated by news stories and articles from MajorGeeks.


MajorGeeks Software Updates and News v4.0.2.0 | MajorGeeks.com
Search MajorGeeks.com
Oct 31, 2024
Oct 30, 2024
Installed Apps
Filter
Check for updates for your installed apps
Articles
News
Deals
Trick or Treat

App name	Current version	Available version	ID
✓ Files	3.7.11.0	Up to date	MSIX\Files_3.7.11.0_x64__1...
FreeTube 0.21.3	0.21.3	0.22.0	PrestonN.FreeTube
✓ Game Bar	7.224.9242.0	Up to date	MSIX\Microsoft.XboxGaming...
✓ GlanceGuest version 4.8.0.32	4.8.0.32	Up to date	ARP\Machine\X86\{F5AC540...
✓ Gmail	1.0	Up to date	ARP\User\X64\0a00f34fc284...
✓ Gmail	1.0	Up to date	ARP\User\X64\b0d166cdfd1...
GNU Privacy Guard	2.4.5	2.4.6	GnuPG.GnuPG
Google Chrome	130.0.6723.70	130.0.6723.92	Google.Chrome.EXE
✓ Google Chrome Beta	131.0.6778.24	Up to date	Google.Chrome.Beta.EXE
✓ Google Chrome Canary	132.0.6809.0	Up to date	
✓ Google Drive	1.0	Up to date	
✓ Google Drive	1.0	Up to date	
✓ Google Drive	99.0.0.0	Up to date	

Update check complete!

Number of apps installed: 266
Number of updates available: 9

Select any red apps in the list that you wish to update and click the "Start updates" button, or double-click any single red app to update just that particular one alone.

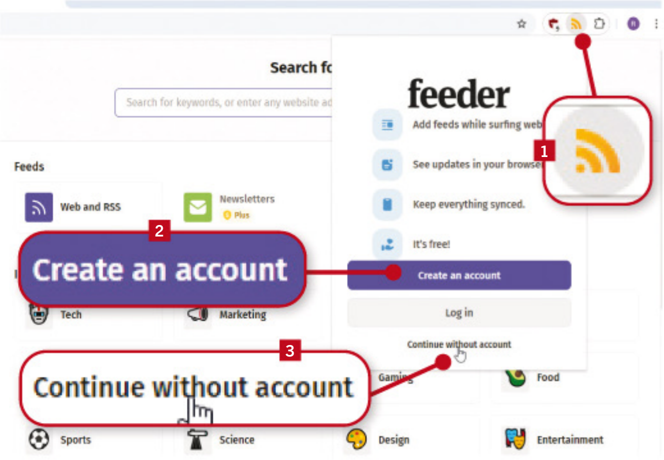
Shopping Smarter with Capital One Sh
How To Make Personalized Screen Sa
Desktop Slideshow Customization: Ho
Get in the Spirit of Halloween With The
Why GDPR is Rather Pointless—and a
Manifest V3, Ad Blockers, Extensions and What You Should Know
Skip the Ads: A Clever Trick to Watch Youtube Ad Free
What Is The Dark Web: A Beginner's Guide To Exploring The Dark Web
Google's New Dark Web Report: How to Use It To Protect Your Data and Alternatives for Non-Google Users
How People Hack Your Webcam And How to Stop It

The MajorGeeks software updater detects updates for a huge number of programs.

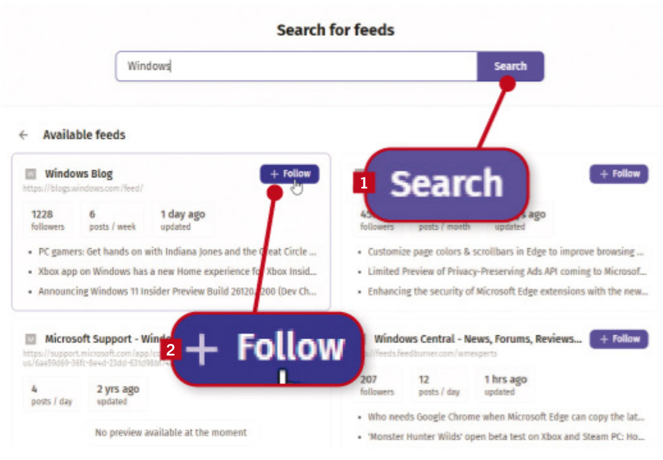
SUBSCRIBE TO RSS FEEDS FOR SOFTWARE UPDATES

Another way to ensure you never miss another software update is to subscribe to the RSS feeds of developers, download sites and software-news sources. These will notify you when a new version of a program is released, so you can either click through to the website to install it or use the update option in the software itself.

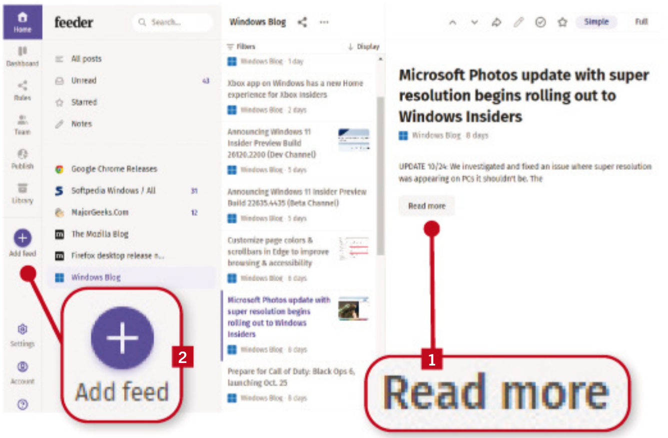
The best way to subscribe to RSS feeds is to install a feed-reading extension in your browser. Our favourite is Feeder's RSS Feed Reader, which is available for Chromium browsers (**www.snipca.com/52634**) and Firefox (**www.snipca.com/52633**). This lets you follow up to 200 feeds for free and checks for new content every 30 minutes.


feeder
Add feeds while surfing web
See updates in your browser
Keep everything synced.
It's free!
Create an account
Log in
Continue without account
Feeds
Web and RSS
Newsletters
Tech
Marketing
Sports
Science
Design
Entertainment
Food
1
2
3

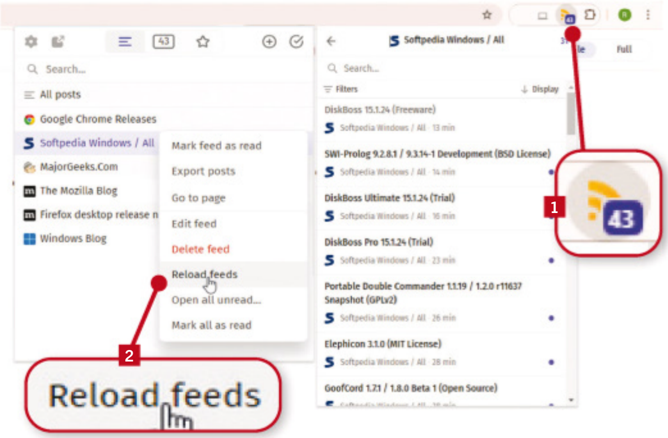
1 To get started, install the Feeder extension in your browser and pin its button to the toolbar for easy access 1. Click this button and choose either 'Create an account' 2 to sign up with Feeder, or 'Continue without account' 3 to try the service first. Feeder will now open your homepage, where you can search for feeds to subscribe to.


Search for feeds
Windows
Search
Available feeds
Windows Blog
+ Follow
Microsoft Support - Windows
Windows Central - News, Forums, Reviews...
1
2

2 You can either find feeds by typing keywords into the search box or by entering their URLs – we've provided some shortened links in the box at this bottom of the page. Click the Search button 1 to display matching results, then the Follow button 2 to subscribe. The feed will now be added to your Feeder Library, and to the list of feeds on the left of your homepage.


feeder
All posts
Unread
Starred
Notes
Google Chrome Releases
Softpedia Windows / All
MajorGeeks.Com
The Mozilla Blog
Firefox desktop release n...
Windows Blog
Microsoft Photos update with super resolution begins rolling out to Windows Insiders
Read more
Add feed
1
2

3 Click the name of a feed to view the latest content from that site, then select a post and click 'Read more' 1. Click 'Add feed' 2 to find and follow more feeds. On some websites, you can subscribe to RSS feeds simply by clicking their buttons or links. Select 'Feeder' in the 'Follow this Feed with' menu and click Follow to subscribe.

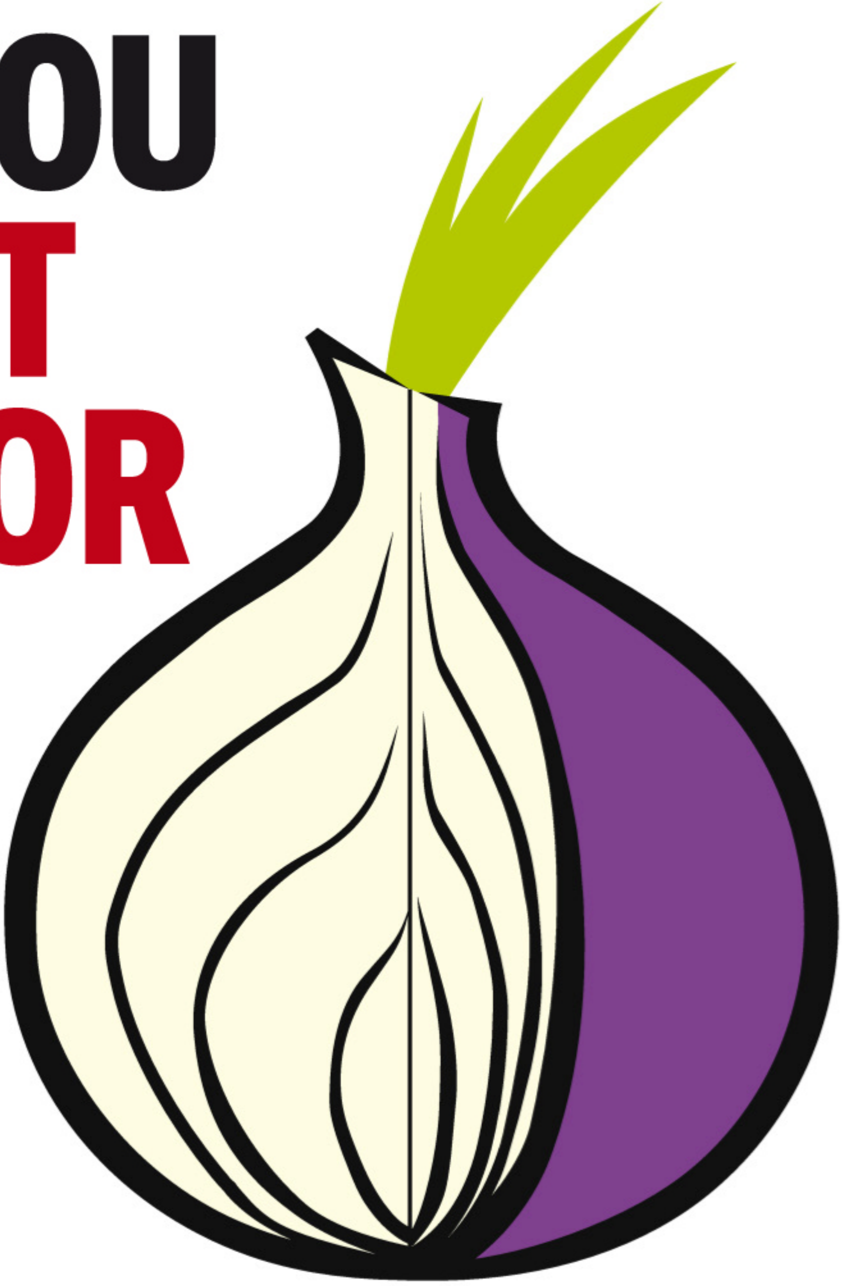

All posts
Google Chrome Releases
Softpedia Windows / All
MajorGeeks.Com
The Mozilla Blog
Firefox desktop release n
Windows Blog
Mark feed as read
Export posts
Go to page
Edit feed
Delete feed
Reload feeds
Open all unread...
Mark all as read
Softpedia Windows / All
43
1
2

4 When Feeder detects new content, it will display a number on its toolbar button 1. Click this followed by the name of the feed to list the latest posts from that site. Select an item to click through to the website and read the full article. To manually check for new content, click the three-dot icon next to a feed and choose 'Reload feeds' 2.

10 RSS FEEDS FOR SOFTWARE UPDATES

- Google Chrome Releases **www.snipca.com/52638**
- MajorGeeks - All New & Updated Downloads **www.snipca.com/52636**
- Microsoft Windows Blog **www.snipca.com/52646**
- Softpedia – Free Windows Downloads **www.snipca.com/52637**
- Firefox Release Notes **www.snipca.com/52643**
- PortableApps.com **www.snipca.com/52639**
- O&O Tools **www.snipca.com/52647**
- Tor Project Blog **www.snipca.com/52645**
- WiseCleaner Updates **www.snipca.com/52644**
- Neowin - Software News **www.snipca.com/52641** ■

WHY YOU MUST USE TOR



Tor is the most private way to access the internet, but it can seem intimidating. **Robert Irvine** explains how to use its browser and network to be completely anonymous online.

WHAT YOU CAN DO

- Hide your location and identity from all websites you visit
- Apply multiple layers of encryption to your data
- Block hidden trackers and personalised adverts
- Delete your browsing data automatically
- Thwart hackers and snoopers when using public Wi-Fi
- Share sensitive files anonymously
- Beat censorship to access blocked sites
- Conceal your Tor usage from your ISP

In previous features, we've recommended a VPN to protect your privacy online. Alternatively you could use a browser like Brave. Both are reliable options, with benefits other than keeping you private, but if you want to be completely anonymous as you browse the web, you can't beat Tor.

Mention Tor to some people and they'll react with concern, because it has an undeserved reputation for being used for shady purposes. While that's not completely unfounded, the Tor Project (**www.torproject.org**), which maintains the Tor network and browser, is a legal, non-profit organisation. It's funded by US federal agencies, private foundations and donors, and its aim is to prevent internet surveillance and censorship – not to enable illegal activities.

Tor's powerful protection against online trackers, hackers and snoopers lets you access websites without revealing your identity, location and activities. In this feature, we explain how it works, the best reasons to use the Tor Browser instead of – or as well as – a VPN and how to access its anonymous network on your PC and mobile device.

In this guide, we'll also show you how to use Tor in the most secure and private ways possible, that includes whether you want to visit standard websites without being spied on, or access legal hidden services that are only available through Tor.

YOUR TOR QUESTIONS ANSWERED

What is Tor?

Tor, which is short for 'the onion router', is an open-source network and web browser that lets you access the internet anonymously. It was created in the mid-1990s by the US Navy to allow secure communication between officers, using a special encryption technique called onion routing.

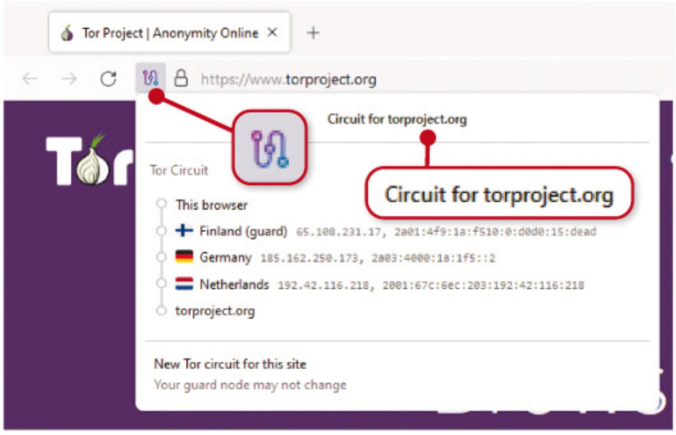
Because Tor conceals your browsing activity, disguises your IP address and blocks trackers, it's popular with whistleblowers and journalists, but it's equally useful for anyone who wants to protect their privacy online. Although its primary purpose is to prevent surveillance, it has many other uses – as we'll explain in this feature.

How does onion routing work?

Onion routing protects your data using multiple layers of encryption (akin to the layers of an onion) then directs it through a series of 'nodes' (servers), which are also known as 'relays'. Each node 'peels away' layers of encryption until your data reaches its final destination – the exit node – where it's fully decrypted.

The Tor network has thousands of nodes in countries all over the world, and when you use it to connect to a website, it plots a random path through these nodes. To reach the site, your internet traffic passes through an entry node server (or 'guard'), at least one middle relay and an exit node, each of which has its own IP address. Tor calls this journey a 'circuit'.

This means nobody can see your real location or the data you're sending and receiving. Sites you visit using Tor will detect your data as coming from the exit node, and the hosts of individual relays never know the complete path your internet traffic has taken.



Tor Project | Anonymity Online

https://www.torproject.org

Circuit for torproject.org

Tor Circuit

This browser

Finland (guard) 65.108.231.17, 2a01:4f9:1a:f510:0:d0d0:15:dead

Germany 185.162.250.173, 2a03:4000:1a:1f5::2

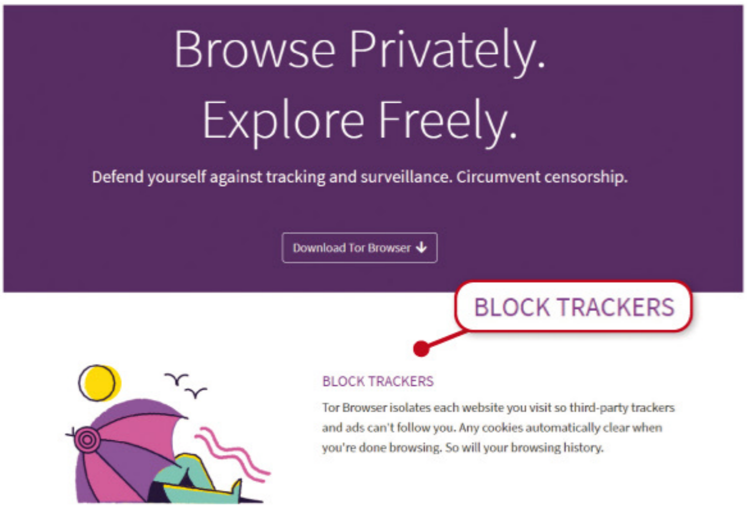
Netherlands 192.42.116.218, 2001:67c:6ec:203:192:42:116:218

torproject.org

New Tor circuit for this site

Your guard node may not change

Tor diverts your internet traffic through a series of 'nodes' called a circuit.



Browse Privately.
Explore Freely.

Defend yourself against tracking and surveillance. Circumvent censorship.

BLOCK TRACKERS

Tor Browser isolates each website you visit so third-party trackers and ads can't follow you. Any cookies automatically clear when you're done browsing. So will your browsing history.

Tor lets you browse the web privately without being tracked and spied on.

How does Tor differ from a VPN?

Both Tor and a VPN encrypt your data and hide your IP address, but they work in different ways. A VPN routes your internet connection through a server owned by the VPN service. This pipes your encrypted data through a secure tunnel between your device and the VPN server, which then forwards it to the site you want to access.

In contrast, Tor sends your data through a random circuit of nodes and relays, which are run by thousands of volunteers around the world. This means you don't need to trust a central service to respect your privacy, and your anonymity is guaranteed.

On the downside, Tor's elaborate routing of your internet traffic makes browsing slower than it would be over a VPN. What's more, it encrypts only what happens in the browser, rather than all the data your device sends and receives.

Is Tor legal to use?

Yes, the Tor network and browser are completely legal to use, though it is blocked or banned by some countries with repressive regimes, including China, Russia and Iran.

The common misconception that Tor is illegal arises from the fact it gives you access to the so-called dark web as well as standard websites. This encompasses special onion sites that you can't access in your usual browser, some of which are used for criminal activities such as trading drugs, weapons and stolen account details.

However, recent statistics suggest that the dark web constitutes only three per cent of Tor traffic (**www.snipca.com/52273**). The vast majority of Tor users are drawn to the network for its privacy benefits, not to exploit it for criminal activities. Tor itself says it is "not a tool designed or intended to be used to break the law" (**www.snipca.com/52274**).

But will I stumble across illegal content?

No. To access an onion website, you need to know its 56-character onion address, so you're extremely unlikely to stumble across one by mistyping a URL. Besides, criminals are far from the only Tor users. Many reputable organisations have onion versions of their sites to help visitors beat censorship and surveillance. We reveal some of the most useful on page 75.

Is Tor safe to use?

The Tor browser is based on Firefox and incorporates most of Mozilla's privacy and security features, plus several of its own. This makes the software itself safe to use, but – as with any browser – your security may be compromised by the sites you visit. We'll explain how to enhance Tor's protection later in this feature.

SEVEN REASONS YOU SHOULD USE TOR

Tor is free to use – with no catches

Most VPNs require a monthly or annual subscription, and even free services usually have a catch. For example, Windscribe VPN's free plan limits you to (an admittedly generous) 10GB of encrypted data per month, while ProtonVPN warns that its free servers are slower than its paid-for ones.

Tor Browser is completely free to use, with no data or speed restrictions, no features limited to a paid-for version (because there isn't one) and no limit to how many devices you can install its software on.

Although you can't choose which servers and countries your encrypted data passes through, the same is true of ProtonVPN's free plan, which automatically assigns you a server.

Tor doesn't collect or share your data

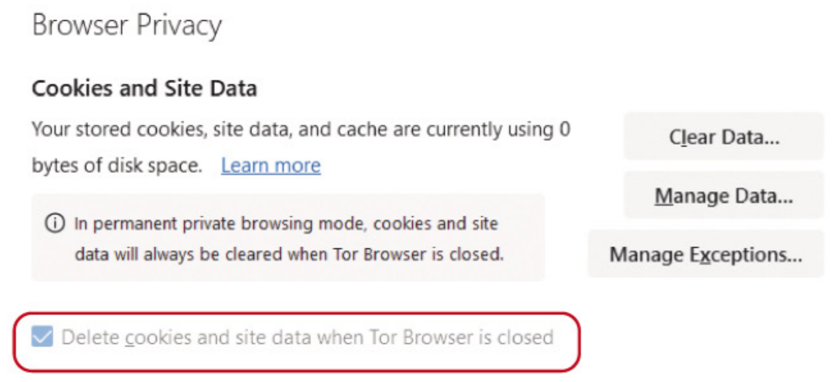
One risk with using VPNs – especially free ones – is that they may keep logs of your supposedly private online activities, and sell this information to advertisers and other third parties. Even otherwise trustworthy VPNs may be obliged to share your usage data with government agencies if they're based in a 'Fourteen Eyes' country (including Australia, New Zealand, the UK, US and most of Northern Europe) and don't have a strict no-logs policy.

There are no such concerns with Tor, because its decentralised network isn't managed or owned by anyone, but is instead run by volunteers. Nobody can collect or view your browsing data, let alone sell it to third parties, or link your activities to your identity.

The browser itself works in permanent private-browsing mode, which means it doesn't store your web history and automatically deletes all cookies and site data when you close it (see screenshot above right). You can't disable this option, but you can allow exceptions for specific websites.

Tor minimises browser fingerprinting

Another drawback of VPNs is that they don't protect you against browser fingerprinting. This tracking technique allows websites to identify you using a unique combination of information about your device – including details of your operating system, hardware specifications, screen resolution, time zone and more.



Your stored cookies, site data, and cache are currently using 0 bytes of disk space. Learn more

ⓘ In permanent private browsing mode, cookies and site data will always be cleared when Tor Browser is closed.

☑ Delete cookies and site data when Tor Browser is closed

Tor automatically deletes cookies and site data when you close the browser.

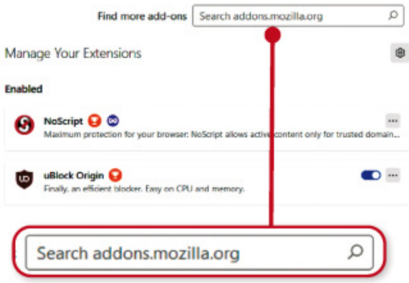
Tor Browser minimises fingerprinting by limiting how much information it shares with sites, although some data, such as your operating system and language preference can't be hidden.

It also uses a technique called 'letterboxing', which adds margins to the browser window, making it harder for sites to identify you from your screen's size and resolution – see **www.snipca.com/52278** for a full explanation.

Tor stops ads and trackers following you

Unlike Brave and DuckDuckGo, Tor Browser doesn't have a built-in ad blocker, so you will see adverts on web pages unless you install an ad-blocking extension such as uBlock Origin. However, by isolating each site you visit, minimising fingerprinting and running in permanent private-browsing mode, it stops ads and trackers following you around the web.

Tor strongly discourages installing add-ons because they contribute to your 'fingerprint' and compromise your anonymity. What's more, hackers can hijack their code to steal your data and infect the browser with malware (see **www.snipca.com/52277**). The browser comes with the script-blocking extension NoScript installed, but Tor says "adding anything else could deanonymise you". If you're willing to take the risk, you can install additional privacy tools from the Firefox Add-ons store (**www.snipca.com/52279**, see screenshot below left).


Find more add-ons
Search addons.mozilla.org
Manage Your Extensions
Enabled
NoScript
Maximum protection for your browser: NoScript allows active content only for trusted domain...
uBlock Origin
Finally, an efficient blocker. Easy on CPU and memory.
Search addons.mozilla.org

Tor advises against installing extensions, but you can do so if you wish.

Tor helps you beat internet censorship

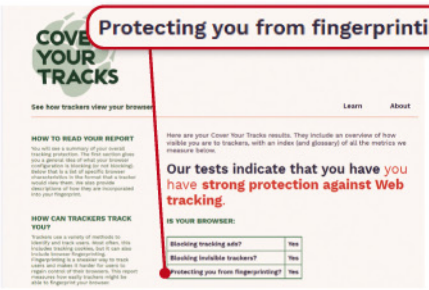
Until now only illegal online content has been censored in Australia. But that could change following the introduction of new legislation which will require identification to use many online services, and limit access to certain sites and services, and require age verification for adult content. Tor lets you bypass this censorship by hiding your IP address and fooling sites into thinking you're in a different, randomly chosen country.

More importantly, Tor enables people who live in countries that heavily censor the internet to access content their government or internet provider doesn't want them to see. It even incorporates a system called Snowflake that helps oppressed citizens use Tor in places where Tor traffic is blocked. Visit **www.snipca.com/52276** to learn how to become a Snowflake volunteer, by setting up a proxy in your browser.

Tor lets you browse anonymously

By encrypting your data, blocking trackers, thwarting fingerprinting and routing your connection through a series of relays, Tor stops anyone seeing what you're doing online and who and where you are.

You can test your anonymity using online tools such as Cover Your Tracks (**www.snipca.com/52283**), which tells you how well you're protected against tracking and fingerprinting, and


COVER YOUR TRACKS
See how trackers view your browser
Learn
About
HOW TO READ YOUR REPORT
HOW CAN TRACKERS TRACK YOU?
Protecting you from fingerprinting? Yes

Here are your Cover Your Tracks results. They include an overview of how visible you are to trackers, with an index (and glossary) of all the metrics we measure below.

Our tests indicate that you have you have strong protection against Web tracking.

IS YOUR BROWSER:

Blocking tracking ads?	Yes
Blocking invisible trackers?	Yes
Protecting you from fingerprinting?	Yes

Online privacy tests confirm that Tor Browser keeps you anonymous.

BrowserLeaks (**www.snipca.com/52281**), which reveals what information your browser is sharing – including your IP address, location and ISP. Tor passes both tests with flying colours), confirming that it's the most private browser available (even Brave fails the BrowserLeaks test).

Tor protects you on public Wi-Fi

Another benefit of onion routing is that it adds a layer of security when using public Wi-Fi networks. These are often unencrypted, which means the network's owners can view your data. Criminals set up Wi-Fi hotspots for this purpose.

Public Wi-Fi is also vulnerable to 'packet sniffing', which lets hackers snoop on your online activities, and 'man-in-the-middle' attacks, which intercept your connection to steal your data. Tor safeguards against both threats, but for total peace of mind you should combine it with a VPN.

HOW TO ACCESS THE TOR NETWORK

Browse with Tor on your computer

To access the Tor network on your PC, download and install Tor Browser from **www.snipca.com/52284**. It's available for Windows 10 and 11 (support for 7 and 8.1 ended recently), macOS and Linux. The latest stable release is version 13.5.6.

When you launch the browser, click the Connect button to connect to the Tor network. To save time in future, turn on the option 'Always connect automatically' (see screenshot **1**).

Once you've made a connection, Tor Browser will open a new tab page with a search box. The default search engine is DuckDuckGo (see screenshot **2**), but you can change this to Startpage in the browser's Search settings. Unsurprisingly, Google and Bing are not listed as options.

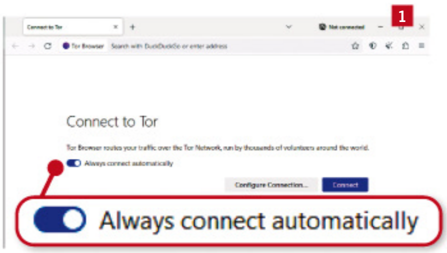
To visit a website, just type its URL into the address bar as you would in any other browser. Because Tor is based on Firefox, its interface and features should feel familiar, including options for adding bookmarks, saving passwords and managing downloads. There are a couple of important extra buttons on the top-right toolbar, which we'll explain in the next section.

When you connect to any site – not just an onion one – you'll see a Tor Circuit button to the left of the address bar (see screenshot **3**). Click it to view the three relays your connection has been sent through, including their locations and IP addresses.

Use Tor on your phone or tablet

You can browse the web anonymously on your Android phone or tablet by installing Tor's official mobile browser (**www.snipca.com/52285**). This works just like the desktop version, with the same privacy benefits, most of the same settings and access to both standard and onion web sites.

1


Connect to Tor
Not connected
Tor Browser
Search with DuckDuckGo or enter address
Configure Connection...
Connect
Always connect automatically

Connect to Tor

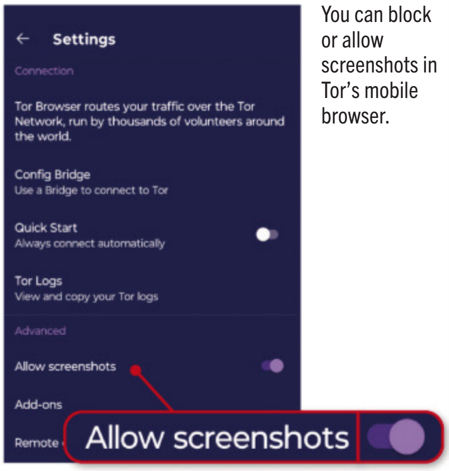
Tor Browser routes your traffic over the Tor Network, run by thousands of volunteers around the world.

Always connect automatically

You can set Tor Browser to always connect to the Tor network automatically.

One notable extra option lets you choose whether to allow screenshots when browsing privately (see screenshot below). Unlike the desktop browser, the Android app also lets you search using your voice, but as this uses Google's speech service, it isn't private.

Apple's strict rules for apps mean Tor doesn't have an official iOS browser, but Tor recommends you use third-party apps Onion Browser (**www.snipca.com/52287**) or Orbot (**www.snipca.com/52288**, also available for Android) to access its network in relative security.


Settings
Connection
Advanced
Add-ons
Remote
Allow screenshots

Tor Browser routes your traffic over the Tor Network, run by thousands of volunteers around the world.

Config Bridge
Use a Bridge to connect to Tor

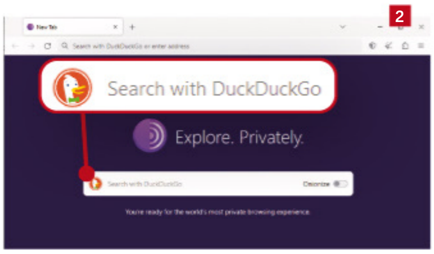
Quick Start
Always connect automatically

Tor Logs
View and copy your Tor logs

Allow screenshots

You can block or allow screenshots in Tor's mobile browser.

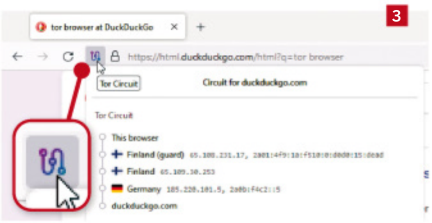
2


New Tab
Search with DuckDuckGo or enter address
Search with DuckDuckGo
Explore. Privately.
Customize

You're ready for the world's most private browsing experience.

Tor Browser's default search engine is the privacy-focused DuckDuckGo.

3


tor browser at DuckDuckGo
https://html.duckduckgo.com/html?q=tor browser
Tor Circuit
Circuit for duckduckgo.com

Tor Circuit
This browser
Finland (guard) 65.108.231.17, 2a01:4f9:1a:f510:0:d0d0:15:dead
Finland 65.109.30.253
Germany 185.220.101.5, 2a0b:f4c2::5
duckduckgo.com

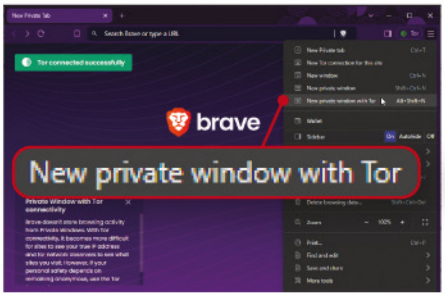
Click the Tor Circuit button to view details of your relays.

Access the Tor network through Brave

If you don't want to download and install yet another private browser, you can access the Tor network using Brave (**www.brave.com**) instead. This offers a Tor mode as well as its standard private-browsing mode, which hides your IP address from sites and stops 'network observers' seeing where you go online.

Activate the feature by going into Brave's Settings, selecting 'Privacy and security' and switching on 'Private window with Tor'. Press Alt+Shift+N to open a private Tor window, or click the three-line menu button and choose 'New private window with Tor' (see screenshot on page 72). Brave will then connect to the Tor network – click Connect if this doesn't happen – so you can browse the web more privately.

Usefully, when you're in standard browsing mode and visit a site with an onion version, Brave shows a purple Tor


Tor connected successfully
brave
New private window with Tor
Private Window with Tor connectivity

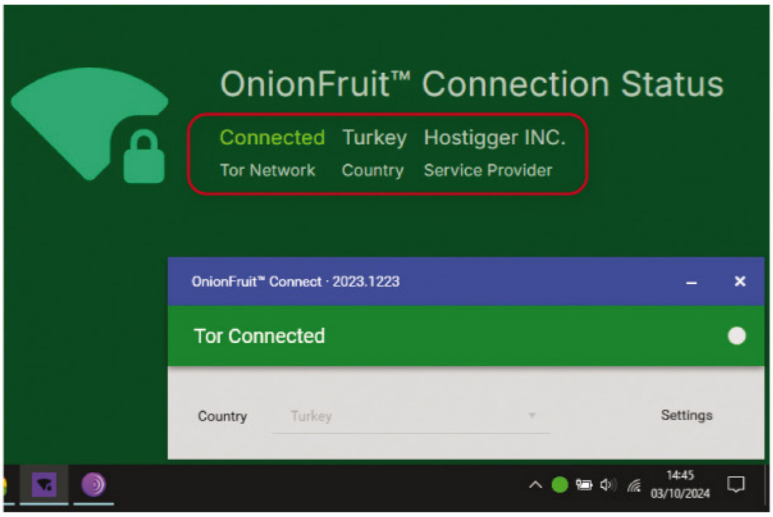
Brave lets you connect to the Tor network without using Tor Browser.

button in its address bar – click it to open the site in a private Tor window.

Note that, unlike Tor Browser, Brave's Tor mode doesn't route your connection through an encrypted circuit of relays. If you want to be completely anonymous, use the Tor browser instead.

Connect to Tor using OnionFruit

Another way to use Tor without the Tor Browser is to install OnionFruit Connect (**www.snipca.com/52292**). This free tool routes your entire internet connection through Tor, so your data is encrypted and your activities concealed in any browser you use.


OnionFruit™ Connection Status
Connected
Tor Network
Turkey
Country
Hostigger INC.
Service Provider
OnionFruit™ Connect · 2023.1223
Tor Connected
Country
Turkey
Settings
14:45
03/10/2024

OnionFruit Connect provides an alternative free way to connect to Tor.

Download and install the program (it requires Microsoft's .NET Framework from **www.snipca.com/52293**), then click the red button in your system tray to launch OnionFruit. Before you switch on the option to connect to the Tor network, you can choose a country to use for your Tor circuit's exit node. This is useful for pretending to be in a particular location, as you can with a VPN.

Once you've connected to Tor, OnionFruit Connect will open a new browser tab confirming your connection status and fake location (see screenshot above). We found that it successfully convinced BrowserLeaks when we were in Turkey, although information leaked by our Chrome browser revealed our real IP address.

OnionFruit has an experimental feature designed to give you access to onion sites, but we couldn't get it to work. To try it, open its Settings, click the DNS tab and switch on Enable Secure DNS.

The home of technology

techradar.com

MAKE TOR EVEN MORE SECURE

Combine Tor with a VPN

It's important to remember that Tor is a proxy service, albeit a very secure one with its relay system and multiple layers of encryption. This means it only encrypts and protects web traffic routed through its browser – not the connection between your computer or mobile device and the internet.

Although Tor conceals your IP address, your ISP can still tell you're connected to the network, because it can see the entry node in your Tor circuit. Currently, Australian ISPs don't block access to Tor, but the fact it can be misused for dubious purposes could make your usage look suspicious.

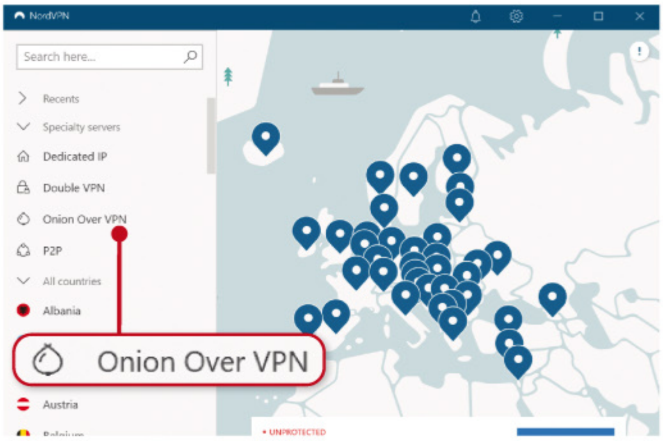
What's more, Tor can't prevent all tracking at the circuit's entry and exit nodes. The person who operates the entry node will see your real IP address, while at the exit node, your decrypted traffic is vulnerable to interception. Tor's network of volunteers are generally trustworthy, but a rogue entry or exit node could put your identity and data at risk – until it's reported and removed by the Tor community.

To address these privacy concerns, you can combine Tor with a VPN. While this will make browsing even slower, it adds an extra layer of protection by encrypting your entire network connection. Most security experts recommend connecting to the VPN before you connect to Tor, which is what happens with NordVPN's 'Onion Over VPN' feature (**www.snipca.com/52299**, see screenshot above right) and Proton VPN's 'Tor over VPN' option (**www.snipca.com/52298** – paid-for plans only).

This has the advantages of hiding your Tor usage (but not your VPN usage) from your ISP, shielding your IP address from a circuit's entry node and allowing you to access onion websites. The disadvantage is that the VPN service can see your IP address, so it's important that you choose one you can trust.

Alternatively, connecting to Tor before the VPN stops the latter seeing your location and keeps your data encrypted as it passes through the exit node. However, this method will significantly slow your browsing and downloads, as well as signalling to your ISP that you're using Tor, and may prevent you from accessing onion sites.

Unless you're really paranoid, using Tor Browser or a VPN on its own will give you sufficient online privacy, but it's worth combining the two if you're engaging in particularly sensitive activities.



NordVPN's 'Onion Over VPN' feature combines Tor with a VPN.

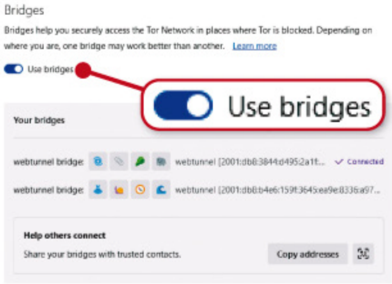
Disguise that you're using the Tor network

Rather than installing a VPN so your ISP and other snoopers can't tell you're using Tor, you can use the browser's 'bridges' feature. Bridges disguise onion routing as standard internet traffic, so you can avoid surveillance and beat censorship without third parties knowing that's what you're doing.

Snowflake is one example of a Tor bridge, and earlier this year the Tor Project launched an even more sophisticated bridge called WebTunnel (**www.snipca.com/52303**). This more closely mimics ordinary HTTPS traffic, "giving the impression that the user is simply browsing the web".

To use WebTunnel, visit Tor's Bridges site (**www.snipca.com/52304**), select 'webtunnel' and click Get Bridges. Click 'Copy All' to copy the bridge code, then go into Tor's Settings, click Connection and choose 'Add new bridges'. Paste the code in the 'Bridge addresses' box then click Next followed by OK.

This will activate the 'Use bridges' option (see screenshot below left), allowing you to conceal your Tor usage from nosy parkers. Switch it off again if you have trouble connecting to websites.



Bridges

Bridges help you securely access the Tor Network in places where Tor is blocked. Depending on where you are, one bridge may work better than another. Learn more

Use bridges

Use bridges

Your bridges

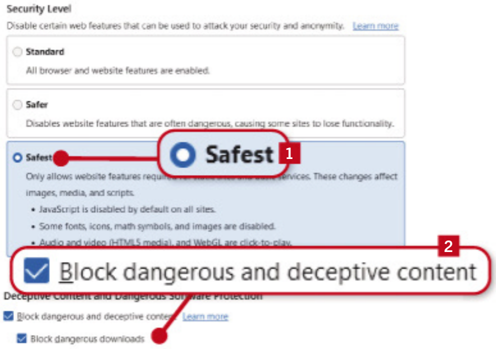
webtunnel bridge: webtunnel [2001:db8:3844:d495:2a1f... ✓ Connected

webtunnel bridge: webtunnel [2001:db8:b4e6:159f:3645:ea9e:8336:a97...

Help others connect

Share your bridges with trusted contacts.

Use the new WebTunnel bridge to stop anyone knowing you're using Tor.



Security Level

Disable certain web features that can be used to attack your security and anonymity. Learn more

○ Standard

All browser and website features are enabled.

○ Safer

Disables website features that are often dangerous, causing some sites to lose functionality.

● Safest

Safest 1

Only allows website features required for static sites and basic services. These changes affect images, media, and scripts.

- JavaScript is disabled by default on all sites.
- Some fonts, icons, math symbols, and images are disabled.
- Audio and video (HTML5 media), and WebGL are click-to-play.

2

☑ Block dangerous and deceptive content

Deceptive Content and Dangerous Software Protection

☑ Block dangerous and deceptive content Learn more

☑ Block dangerous downloads

Tweak Tor's security settings to protect yourself from dangerous web content.

Set Tor's security to its highest level

Tor Browser offers a choice of security levels to help you strike the right balance between blocking web elements that compromise your privacy and safety, and ensuring web pages load properly. This is particularly important on download and streaming sites, which are often riddled with deceptive ads, malicious scripts and intrusive pop-ups.

Click the 'Security level' (shield) icon in the browser's top-right toolbar and choose Settings to select your default security level. 'Standard' enables all browser and website features, and is therefore the riskiest option, while 'Safest' (1 in our screenshot above) disables all non-essential elements including JavaScript, some fonts and images, and autoplaying audio, video and animation.

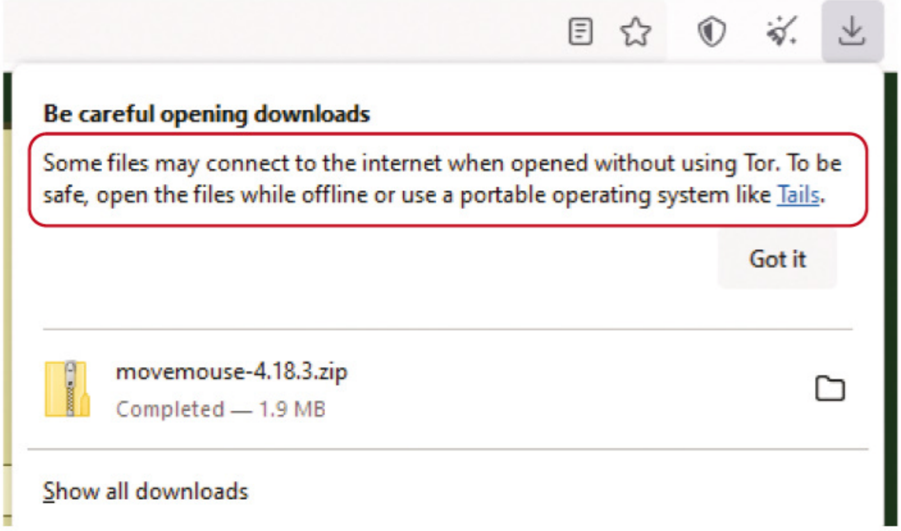
If this stops a specific site loading, click the Shield icon again and change the Security Level to Safer. You should also enable the option to 'Block dangerous and deceptive content' 2.

Open Tor downloads safely

Although Tor Browser keeps you anonymous when downloading files from the internet, there's a risk that the files themselves could compromise your privacy. When you open a download, it may automatically connect to the internet without the benefit of Tor's protection, revealing information about you.

Your antivirus software should mitigate this risk, but to be on the safe side Tor recommends only opening downloaded files when you're offline (see screenshot right). It also suggests using the secure portable operating system Tails (**https://tails.net**) to download and open files so they can't infect your main PC.

If Tails seems like overkill, consider using a sandboxing program such as Sandboxie Plus (**www.snipca.com/52308**) to isolate your downloads so you can open them safely and anonymously.



Be careful opening downloads

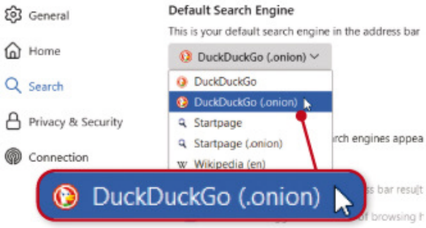
Some files may connect to the internet when opened without using Tor. To be safe, open the files while offline or use a portable operating system like Tails.

Tor recommends that you only open downloaded files when offline or using Tails.

Switch to the 'onion' version of DuckDuckGo

As we mentioned, Tor Browser's default search engine is the privacy-focused DuckDuckGo, which doesn't store your search history or personal data and won't track you. To make sure nobody can see what you're searching for, switch to DuckDuckGo's onion version, which applies end-to-end encryption to your Tor searches (though it won't let you search the dark web).

The easiest way to do this is to use the search box on Tor Browser's New Tab page. Simply type your query and select the Onionize option to direct your search through DuckDuckGo's onion service. Alternatively, click the 'DuckDuckGo (.onion)' button when searching from the address bar, or access the site directly at **www.snipca.com/52309** (this link will only work in Tor).



Default Search Engine

This is your default search engine in the address bar

DuckDuckGo (.onion)

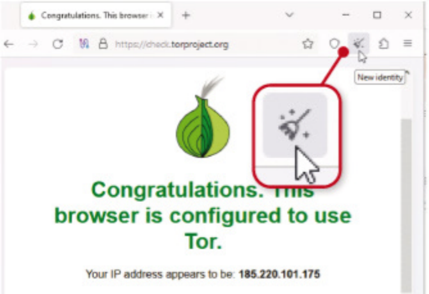
Search anonymously in Tor using DuckDuckGo's onion version.

To make the onion version your default search engine, go into Tor Browser's Settings, click Search and select 'DuckDuckGo (.onion)' in the Default Search Engine menu (see screenshot below left).

Reset your Tor circuit and identity

The exit node in a Tor circuit is the point where your encrypted traffic rejoins the 'normal' internet, so it's essential that you can trust it with your data. To verify this, visit **www.snipca.com/52310** to make sure Tor is working properly, then click Relay Search. This will provide detailed information about the exit node, including its IP address, location, host and uptime (how long it's been running).

If these details don't look right, click the 'Tor circuit' button and choose 'New Tor circuit for this site' to use a different path. If you suspect your anonymity has been compromised, click the 'New identity' (brush) button in the top-right toolbar (see screenshot below). This resets your connection and restarts the browser with a new identity and circuit, so your subsequent activity can't be linked to



Congratulations. This browser is configured to use Tor.

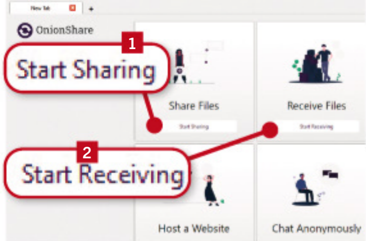
Your IP address appears to be: 185.220.101.175

Click the 'New identity' button to restart Tor with a fresh connection.

SHARE AND RECEIVE FILES SECURELY USING TOR

A free tool called OnionShare (**www.snipca.com/52311**) lets you send and receive files securely and anonymously over the Tor network. Install the app on your PC (it's also available for macOS, Linux, Android and iOS), click 'Connect to Tor' and choose Start Sharing on the Share Files tile (1 in our screenshot). Add the files or folders you want to share and click 'Start sharing'. This will generate an onion address your intended recipient can use in Tor Browser to access the shared items — click Copy Address to paste it into an encrypted email or chat. You also need to send the other person the private key generated by OnionShare, so they can unlock the download. Click 'Stop sharing' to remove files once downloaded.

To allow someone to send you files through Tor Browser, click Start Receiving on the Receive Files tile 2, then Start Receive Mode to generate another onion address and private key. The sender can then enter these in the browser to upload files to you.



ONION SITES YOU CAN ACCESS WITH TOR

Although you can access standard websites through Tor, onion sites – which have a '.onion' domain – are much more private. Their IP addresses and locations are hidden, your connection to them is protected with end-to-end encryption, and there's no exit node where your data can be intercepted.

Tor Browser tells you when the site you're currently visiting has an onion version, by displaying a purple 'onion available' button in its address bar (see screenshot below). Click this to switch and boost your privacy.

You can also visit onion sites directly if you know their 56-character address. Here are some of the most interesting – and legal – examples. We've shortened the URLs using our Snipca service (they won't work in your standard browser).

BBC News

www.snipca.com/52314

Yes, you can access BBC News in any browser, but not in a country where the internet is censored. Launched in 2019, the Beeb's 'dark web mirror' provides breaking news from around the world.

Proton

www.snipca.com/52321

Proton tools, including Proton Mail and Drive, already use end-to-end encryption. Its onion website offers extra privacy by letting you access its services anonymously, hiding your IP address and concealing that you're using them.

ProPublica

www.snipca.com/52335

This Pulitzer Prize-winning news site launched a 'Tor hidden service' in 2016 to let visitors read its content without being spied on. Its investigative journalism covers topics including political corruption, digital surveillance and pharmaceutical profiteering.

Tor Metrics

www.snipca.com/52325

As well as the onion version of its main website (**www.snipca.com/52324**), the Tor Project also offers this resource. It provides interesting statistics about Tor's popularity, performance and traffic (see screenshot below left), and the number (but not addresses) of onion services.

Mail2Tor

www.snipca.com/52323

Logging into Gmail or Outlook in Tor will reveal your identity instantly. Mail2Tor offers a private free alternative for sending and receiving emails anonymously. Messages are encrypted, and the site doesn't log your IP address.

Mullvad

www.snipca.com/52326

The company behind Mullvad's VPN and browser, which was developed in collaboration with the Tor Project, has an onion service that lets you sign up for and download its software in secrecy.

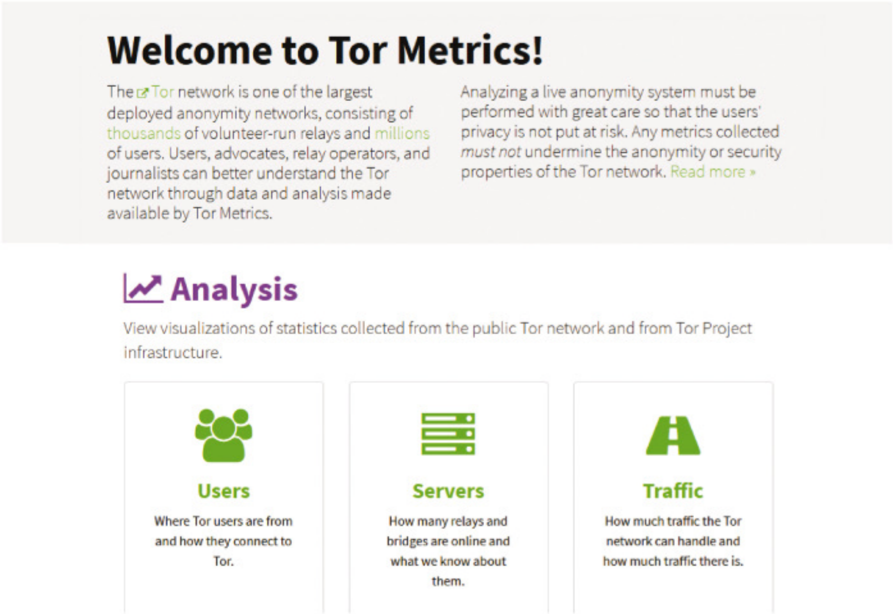
Facebook

www.snipca.com/52327

Rather ironically, the social network that's infamous for collecting its users' data has a private version that can only be accessed through Tor. This provides a secure method of communication for users worried about surveillance. ■

HAS TOR'S ANONYMITY BEEN COMPROMISED?

In September, German news outlet NDR reported that law-enforcement agencies had succeeded in 'de-anonymising' several Tor users, in what it described as a "major blow for the Tor Project" (**www.snipca.com/52328**). This triggered concerns that the private browser may not be as private as previously thought. Tor refuted the allegation in a blog post titled 'Is Tor still safe to use?' (**www.snipca.com/52330**). Based on the "limited information" provided by NDR, it suggested that the de-anonymisation related to a "long discontinued" messaging app called Ricochet, which let users chat securely over the Tor network. Tor believes the outdated software allowed a user to be identified through a breach of the guard (entry) node in their Tor circuit, and that the attack is likely to have happened several years ago. It said: "one thing is clear: Tor users can continue to use Tor Browser to access the web securely and anonymously", but stressed the importance of keeping any Tor-related software up to date.



Welcome to Tor Metrics!

The Tor network is one of the largest deployed anonymity networks, consisting of thousands of volunteer-run relays and millions of users. Users, advocates, relay operators, and journalists can better understand the Tor network through data and analysis made available by Tor Metrics.

Analyzing a live anonymity system must be performed with great care so that the users' privacy is not put at risk. Any metrics collected *must not* undermine the anonymity or security properties of the Tor network. Read more »

Analysis

View visualizations of statistics collected from the public Tor network and from Tor Project infrastructure.

Users

Where Tor users are from and how they connect to Tor.

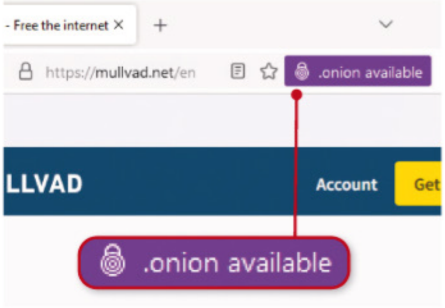
Servers

How many relays and bridges are online and what we know about them.

Traffic

How much traffic the Tor network can handle and how much traffic there is.

Tor Metrics provides interesting statistics about the network.



Click this button to switch to the onion version of a site.

PC BUILDER

From the front lines of the Australian PC market

System news

The Battlemage takes +100 DMG, losing its head, then takes a $7.9B healing potion to recover. Mark Williams watches the survival games at Intel unfold.

Intel continues its stroll down struggle street with the big news that CEO Pat Gelsinger has stepped down. While the press release makes it sound like he left of his own accord, with so much pressure on Intel to turn things around and Gelsinger's transformative vision for Intel still in the works, Intel finds itself in financially dire straits. The fact that Gelsinger stepped out immediately and was simultaneously removed from the board of directors, with no known health or family issues that might otherwise explain the immediacy of the move, suggests he was forced out rather than of his own accord.

He's being replaced by two temporary appointments, David Zinsner and Michelle Johnston Holthaus as interim Co-CEOs. Zinsner, previously chief financial officer, will be obviously keeping an eye on the financials to keep things afloat, and Holthaus has been appointed the newly created position of CEO of Intel Products, which encompasses all of Intel's product groups, from client compute to data centre, AI and networking.

Intel has been struggling for a while now and one thing that didn't help Gelsinger's position was a statement he made about TSMC. Intel is currently using TSMC to make parts for its latest processors, but with plans to build up Intel Foundry Services to the same level. In an interview, Gelsinger mentioned that "You don't want all of your eggs in the basket of a Taiwan fab". Hinting at regional tensions with China. TSMC took offence to his statement and reportedly removed the 40% volume discount Intel was enjoying with TSMC.

While severe, likely the real nail in his coffin is Intel's 18A manufacturing node. As the final step in Gelsinger's "five nodes in four years" foundry update strategy to get Intel back on track to lead the industry, his plan hinged on 18A being a success.

Previously Broadcom was one of the first external companies to trial Intel's 18A manufacturing node. However, after receiving their test wafers Broadcom concluded that the node wasn't ready for high-volume production and walked away. With rumours swirling that 18A yields are at a miserable 10%, it's no wonder things are looking bad. If Intel must continue to rely on full price TSMC services for now, and its fabs aren't bringing in external customer revenue, Intel is haemorrhaging more money than it otherwise would have or planned for.

In a move we haven't seen since AMD's 2013 financial low point, where it sold and then leased back office space to generate some cash, Intel is now doing the same with its Folsom site in California, with more sites around the world also to be sold off.

It's not all bad news though with the American federal CHIPS act money to the tune of US$7.89B was finally approved (with some restrictions around foreign ownership limits), it'll be a welcome cash injection to get its foundries fully functional.

Maintaining a strong front, Intel announced its next-generation Battlemage ARC graphics cards to its fledgling lineup. While lots of performance uplifts and improvements have been claimed over Alchemist, reading between the lines of the stats and claimed performance it leaves some concerning questions about Battlemages' ultimate real-world competitiveness and profitability. Let's hope reviews turn out favourably for Intel, otherwise, we could see them dropping discrete card development altogether just to keep the lights on while they sort things out. ■

Mark Williams is an IT professional with a strong interest in voiding warranties.

Market Watch

A sampling of PC systems available this month

CPL ONLINE INFINITY 7

$1,559

tinyurl.com/APC541CPL

Keeping prices low these days unfortunately means using two generation old hardware to get the job done. The Ryzen 5600 was solid back in the day is today still acceptable especially when paired with the RTX 4060, though will hamper anything faster. This combination means for gaming 1080p is the limit of what this system can run well with latest games.

A particularly nice aspect of this build is the dual SSD storage with 500GB and 1TB SSDs included we've more storage at this price point than with other systems. The 750W PSU is generous here too and offers quite a bit of headroom for future upgrade choices.

A system with above average value that's eager for future upgrades.

CPU AMD Ryzen 5 5600; **COOLER** OEM; **MOTHERBOARD** Asus Prime B550M-A WIFI II; **GRAPHICS** MSI GeForce RTX 4060 Ventus 2X 8GB OC GDDR6; **MEMORY** 16GB Team T-Force Delta RGB Series DDR4 3600MHz; **STORAGE** 500GB Kingston SNV2S M.2 PCIe 4.0 NVMe SSD, 1TB Kingston SNV2S M.2 PCIe 4.0 NVMe SSD; **POWER SUPPLY** SilverStone DA750-G 750W; **CASE** Cooler Master CMP520.

MWAVE KATANA FRIDAY

$1,499

tinyurl.com/APC541MWV

Matching the CPL system for major component choices, this system will perform basically the same. Coming in a tad cheaper though it does however drop to the more standard single 1TB SSD for storage and for this price point 650W PSU, meaning less capacity for future upgrades.

The 8GB of VRAM limits latest gaming titles to 1080p when gaming with raytracing only really being viable when DLSS is enabled as well. Like the CPL system the Ryzen 5000 series favoured 3600MHz RAM is included for best memory performance.

If you don't care for upgrading components later, saving the extra $60 here will be appreciated.

CPU AMD Ryzen 5 5600; **COOLER** OEM; Motherboard Asus Prime B550M-A WIFI II; **GRAPHICS** Asus GeForce RTX 4060 Dual OC V2 8GB; **MEMORY** 16GB Team Delta RGB DDR4 3600MHz; **STORAGE** 1TB Crucial P3 Plus Gen4 NVMe SSD; **POWER SUPPLY** MSI MAG A650BN 650W; **CASE** MSI MAG Forge M100R.

BPCTECH KRAKEN POWER ORION

$2,999

tinyurl.com/APC541BPC

While the components in this system aren't top of the range, that also means the price thankfully isn't top of the range either. The Ryzen 7 9700X didn't light the world on fire compared to Ryzen 7000 series performance, but did in terms of power consumption, meaning the included 360mm AIO is a little overkill here.

16GB of 5600MHz RAM is a little disappointing to see here with 32GB becoming standard this is a little behind the 8-ball especially with the slower speed.

A great 4K capable system slightly let down by the memory. The option on the webpage to upgrade to a faster 32GB RAM kit for $89 extra is highly recommended!

CPU AMD Ryzen 7 9700X; **COOLER** Valkyrie Dragonfang 360 AIO; **MOTHERBOARD** Gigabyte B650M Gaming WIFI; **GRAPHICS** Gigabyte GeForce RTX 4080 Super Windforce V2 16GB GDDR6X; **MEMORY** 16GB Team T-Force Delta RGB DDR5 5600MHz; **STORAGE** 1TB Klevv Cras C910 M.2 SSD; **POWER SUPPLY** Thermaltake Toughpower GF A3 850W **CASE** MSI MAG Pano M100R PZ.

PC CASE GEAR PHANTOM

$3,299

tinyurl.com/APC541PCC

Coming in $300 more than the BPCtech system, this feels like it packs in more than that one. The 14700F CPU is a multithreading powerhouse in comparison. As such it does run hot but is cooled with a beefy 360mm AIO to mitigate that.

The 32GB of faster DDR5 RAM included is much more in line with what we expect to see at this price point and the move up to a 2TB SSD rounds out the headline benefits over the BPCtech system. An 850W PSU is found here too but with the power-hungry CPU, future upgrades to the GPU should be considered carefully.

An otherwise all-round solid build that's ready for serious work and play.

CPU Intel Core i7 14700F; **COOLER** Phanteks Glacier 360mm AIO; **MOTHERBOARD** Gigabyte B760 Gaming X AX; **GRAPHICS** Zotac Gaming GeForce RTX 4080 Super Trinity 16GB; **MEMORY** 32GB Lexar Ares RGB DDR5 6400MHz CL32 **STORAGE** 2TB Lexar NM790 M.2 PCIe Gen4 NVMe SSD; **POWER SUPPLY** Phanteks AMP GH 850W; **CASE** Phanteks XT View.

Blueprints

Value- and performance-driven hypothetical builds

Budget. A perfect balance between price and performance.

Well folks, there we have it: two whole new generations of processors, and well, we're still recommending the last generation across the majority of our builds. It's a little bit wild out there right now. What's the big holdup, then? Why aren't we jumping ship to Intel and AMD's latest and greatest? Simply put, it's all a matter of price. Right now, both Team Blue's 14th gen and Team Red's 7000 series have been hit with a serious RRP hammer; the numbers don't lie, and we've seen price drops of well over $100 in some cases over the last few months. This is, of course, intended to try and shift the remaining stock out of Intel and AMD's warehouses, yet bizarrely, given how little extra performance you're getting with the new chips, it has had the effect of making the older chips insanely good value for money. Weird, huh?

Our budget builds, then, have seen very little change outside of us just trying to hold on to those prices wherever we could. We've shifted both builds over to a new Thermaltake Litepower Gen3 650W 80+ PSU, in the process bumping up that maximum capacity by 50W in anticipation of new GPUs potentially drawing more juice in the coming months, but otherwise, there was very little that needed shuffling around. Pricing sort of flattened out between the two of them. Our AMD system in particular was an example of this, coming in at $101 less than it was last month.

Our Intel system had a touch more trouble; our motherboard of choice from last issue had its price bumped up, and although there are cheaper boards to be had out there, to give it some parity with our AMD system, we decided to grab an Gigabyte B760 DS3H AX motherboard instead. That did bump the overall price up, but it's well worth it for the extra connectivity (and a healthier-looking system).

AMD BUILD Approximate Price $1,393

Case		Phanteks XT View	$129
PSU	NEW	**Thermaltake Litepower Gen3 650W 80+**	**$79**
Mobo		MSI PRO B650-S WiFi	$249
CPU		AMD Ryzen 5 7600	$288
GPU	NEW	**Asrock Challenger D Arc A750 8GB**	**$299**
RAM		Team T-Force Vulcan Alpha 32GB (2x16GB) 6000MHz CL38 DDR5	$155
SSD		500GB Crucial P3 Plus PCIe 4.0 M.2	$55
SSD		1TB Kingston NV2 PCIe 4.0 M.2	$79
OS		Windows 10 Home 64-bit OEM (Windows 11 Compatible)	$60

Intel BUILD Approximate Price $1,474

Case		Phanteks XT View	$129
PSU	NEW	**Thermaltake Litepower Gen3 650W 80+**	**$79**
Mobo	NEW	**Gigabyte B760 DS3H AX**	**$229**
CPU		Intel Core i5-14400F	$259
GPU	NEW	**Gigabyte Radeon RX 7600 Gaming OC**	**$429**
RAM		Team T-Force Vulcan Alpha 32GB (2x16GB) 6000MHz CL38 DDR5	$155
SSD		500GB Crucial P3 Plus PCIe 4.0 M.2	$55
SSD		1TB Kingston NV2 PCIe 4.0 M.2	$79
OS		Windows 10 Home 64-bit OEM (Windows 11 Compatible)	$60

AMD BUILD Approximate Price $2,989

Case		Hyte Y40 ATX Mid Tower	$199
PSU		850W Thermaltake Toughpower GF A3 80+ Gold	$145
Mobo	NEW	**Gigabyte X870 Eagle WiFi**	**$459**
CPU		AMD Ryzen 7 9700X	$459
Cooler		Noctua NH-D12L Chromax.Black	$535
GPU	NEW	**Asus Dual Radeon RX 7700 XT OC Edition**	**$609**
RAM		32GB (2x 16GB) TeamGroup T-Create Expert @ 6,400 C32	$194
SSD	NEW	**1TB Corsair MP600 Elite w/ Heatsink M.2 PCIe 4.0 SSD**	**$134**
SSD		2TB Silicon Power UD90 M.2 PCIe 4.0 SSD	$195
OS		Windows 10 Home 64-bit OEM (Windows 11 Compatible)	$60

Intel BUILD Approximate Price $2,688

Case		Hyte Y40 ATX Mid Tower	$199
PSU		850W Thermaltake Toughpower GF A3 80+ Gold	$145
Mobo	NEW	**MSI Pro Z790-VC WiFi**	**$307**
CPU		Intel Core i7-14700F	$499
Cooler		Cooler Master MasterLiquid ML360L ARGB V2 360mm AIO	$130
GPU	NEW	**PNY XLR8 Gaming Verto** Epic-X **RGB RTX 4070 12GB**	**$829**
RAM		32GB (2x16GB) Silicon Power Xpower Zenith Gaming @ 6000 C30	$190
SSD	NEW	**1TB Corsair MP600 Elite w/ Heatsink M.2 PCIe 4.0 SSD**	**$139**
SSD		2TB Silicon Power UD90 M.2 PCIe 4.0 SSD	$195
OS		Windows 10 Home 64-bit OEM (Windows 11 Compatible)	$60

Mid-range. A game-ready machine that can also handle demanding work.

Fortunately for us (having no product changes to talk about puts a dampener on the write-up for these builds), our AMD and Intel systems in the mid-range have had a few changes for us to chat shop about. Interestingly, both rigs had motherboard and GPU swaps to help mitigate some rather hefty price hikes.

Our AMD build in particular saw a price rise on the Asrock X670E Pro RS from last month, so we've opted to go with its newer X870 sibling instead. Plus, with this change, you won't need to update the BIOS to get it running, which certainly helps. We've also swapped out from the Gigabyte Gaming RX 7700 XT for the Asus Dual Radeon RX 7700 XT OC Edition variant instead. Although the Gigabyte card didn't see a major increase in price, we've done this to offset a few other price hikes in our mid-range setup.

As for Intel, it was exactly the same problem; the GPU and motherboard both received price bumps, with the Pro Z790-S from last month increasing, and our MSI Ventus 2X RTX 4070 also bouncing up. Not ideal, but again, we managed to snag a few good bargains. In goes the Gigabyte X870 Eagle WiFi otherboard, which is very well priced at $459.

The MSI Pro Z790-VC WiFi managed to slide in at just $307, and we spotted PNY's XLR8 Gaming Verto Epic-X RGB RTX 4070 for an outstanding $829, bringing the price down by $40 compared to last month (there must be a manufacturer competition for who's got the most ridiculous product name).

Both systems have received a nice uptick in SSD performance, too; we've ditched Lexar's NM790 for Corsair's MP600 Elite. That packs in some lovely Kioxia 162-layer TLC NAND with Phison's E27T controller to deliver top-notch performance for our needs here. And yes, the AMD build here is the only one in this month's Blueprints with a current-gen chip in it.

High-end. The ultimate do-anything-with-ease PC.

Anyone been watching the latest season of *Arcane* lately? Seriously good, that. Okay, enough stalling. Yes, we've made one change to both of our Turbo builds this month, and that's on the primary OS SSD for these builds. We've ditched MSI's Spatium M570 HS for Crucial's T700 instead. Both of them are PCIe 5.0 drives, and basically come with the same hardware, but the MSI SSD saw a price hike last month. The T700 didn't exactly escape that NAND hike either, but it's only a few dollars more than last issue, and it is one of the best PCIe 5.0 SSDs that we've tested to date second only to the T705.

Why no changes otherwise, though? Well, let us reel off the AMD price changes for you here: PSU unchanged, motherboard unchanged, CPU unchanged, GPU up by $150, RAM up by $40, and the Lexar SSD 2 fell by a paltry $6. The Nzxt Kraken 360 falling by $26 (yet it's still one of the most affordable 360mm AIOs out there), and the chassis remained unchanged, although again, you can grab that in the fanless configuration, or one of the other colourways for a few dollars less, if you're looking to save some money. Overall, those price shuffles have sent the AMD build up by $198 on last issue. It's not a huge amount, all things considered, as it's still $4,610, all in all, but it still comfortably sits around our $5,000 price tag target that we aim for with these builds.

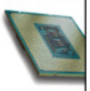
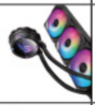
Intel also saw a few price changes. Similarly to our AMD build here, it saw significant price falls across the range. The CPU fell by $14, the cooler by a notable $110, but the SSD shift has brought it up by $120. Not helpful. There were a couple of wins; the motherboard fell by a nice $59, but the PSU and GPU remained the same. Annoyingly, the 14900KF and the K variants are priced about the same here, and without dropping to a 14700K, there's little price shaving to be done. Plus, the Core Ultra 9 285K is still near $415 more than this one currently; never mind the motherboard pricing.

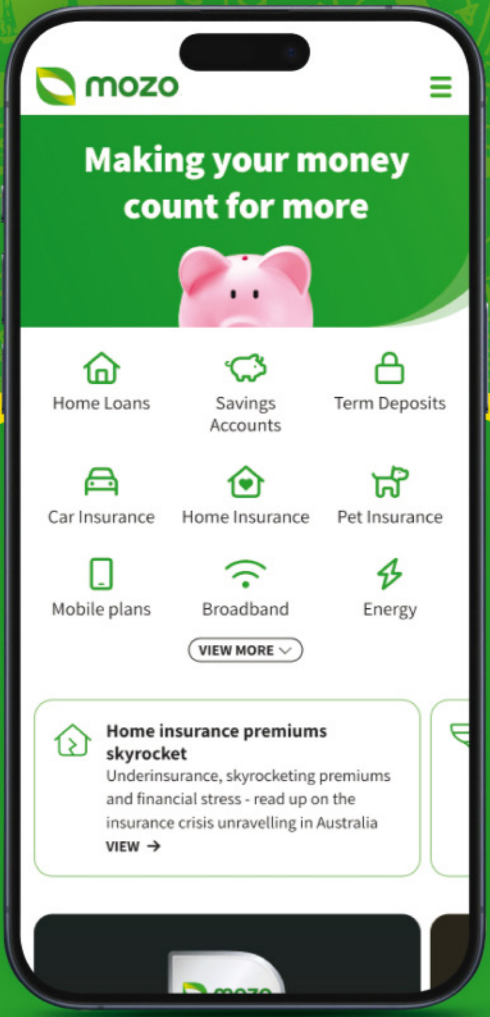
So yes, it's still the best value Turbo Intel build you can get right now. And with everything evening out between the price rises and falls, we don't mind noting that the overall price has fallen by just $1 compared to last month. What a gift, thanks Santa.

AMD BUILD **Approximate Price $4,610**

Case		Phanteks Enthoo Pro 2 Tempered Glass	$289
PSU		Phanteks Revolt 1000W Platinum Fully Modular Power Supply Black	$329
Mobo		MSI MAG X670E Tomahawk Wi-Fi AM5	$458
CPU		AMD Ryzen 9 7950X	$829
Cooler		Nzxt Kraken 360 - 360mm AIO	$229
GPU		Asus Radeon RX 7900 XTX TUF Gaming OC 24GB	$1,549
RAM		64GB (2x32GB) Teamgroup T-Create Expert @ 6000 C34	$279
SSD		NEW **2TB Crucial T700 PCIe 5.0 M.2**	**$399**
SSD		2TB Lexar NM790 PCIe 4.0 M.2	$189
OS		Windows 10 Home 64-bit OEM (Windows 11 Compatible)	$60

Intel BUILD **Approximate Price $4,436**

Case		Phanteks Enthoo Pro 2 Tempered Glass	$289
PSU		Phanteks Revolt 1000W Platinum Fully Modular Power Supply Black	$329
Mobo		Asus Prime Z790-A Wi-Fi	$458
CPU		Intel Core i9-14900KF	$685
Cooler		Asus ROG Strix LC II ARGB 360mm AIO	$159
GPU		PNY GeForce RTX 4080 Super Verto Triple Fan 16GB	$1,589
RAM		64GB (2x32GB) TeamGroup T-Create Expert @ 6000 C34	$279
SSD		NEW **2TB Crucial T700 PCIe 5.0 M.2**	**$399**
SSD		2TB Lexar NM790 PCIe 4.0 M.2	$189
OS		Windows 10 Home 64-bit OEM (Windows 11 Compatible)	$60



mozo

Making your money count for more

Home Loans
Savings Accounts
Term Deposits
Car Insurance
Home Insurance
Pet Insurance
Mobile plans
Broadband
Energy

VIEW MORE

Home insurance premiums skyrocket
Underinsurance, skyrocketing premiums and financial stress - read up on the insurance crisis unravelling in Australia
VIEW →

LOVE SAVING MONEY?

Scan the QR code to sign up to our weekly deals alert.

Compare over 1800 loans, savings & insurance products

mozo.com.au

mozo
The money saving zone

The problem solvers

The *APC* team field problems across the spectrum of devices and software. Learn a new trick or fix you can use.

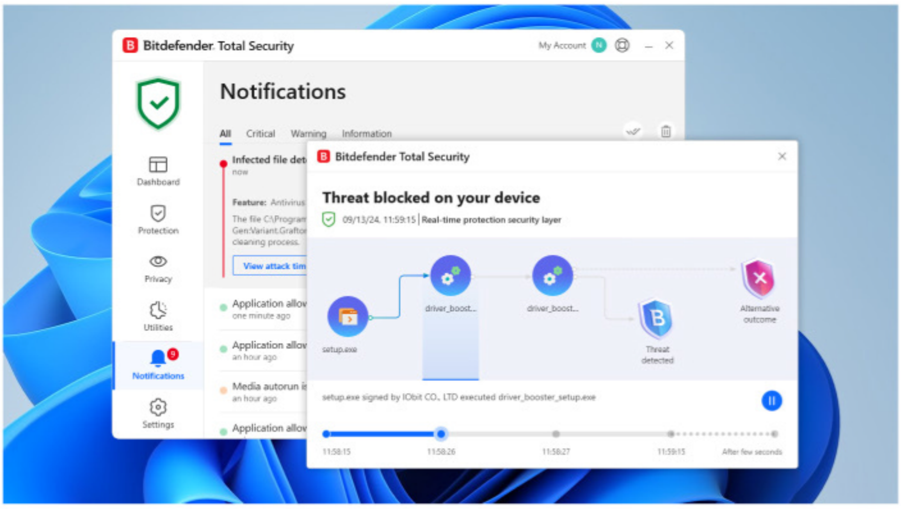
Transfer legacy apps

What is currently considered the best (and easiest) way to migrate programs, settings, and so on to a new PC? I built my last machine back in 2009. Through the years, it has updated from Windows 7 to Windows 11 (with some effort), but has reached its limits. I have some legacy programs that currently work fine, but trying to re-install may not be possible due to the fact that they were supplied on diskettes. Ideally, I'd like to build a brand new machine and clone my existing unit – is that possible? Happy to pay for software.
David Sollish

***APC* Responds:** While it might be technically possible to clone your old hard drive and transfer it to your new PC, that will be fraught with difficulties, and likely cause other issues with an aging Windows installation, however good Windows is at reconfiguring and repairing itself when encountering new hardware.

A better option is to investigate software designed to transfer applications and settings, along with files from one PC to another. This means building your new PC and installing a fresh copy of Windows 11, along with the correct drivers for your system. Also, consider installing key software that doesn't require porting over, such as third-party security software, if you use it.

Once your new PC is ready to receive the transfer, you can install the software on both old and new machines. Believe it or not, that software is PCmover from Laplink – yes, it's still the number one choice for migrating apps, settings, and files from one PC to another. Its Home edition (US$39.95, **https://web.laplink.com/product/pcmover-home**) transfers apps, files, and settings, but only works with single-drive or partition systems, so if you've got multiple drives or partitions to transfer, consider its Pro edition (US$59.95) instead. The program comes with a 30-day money back guarantee in case it's unable to transfer those legacy apps across. The fact that you'll be transferring from one Windows 11 PC to another should maximise your chances of success.


Bitdefender Total Security
My Account
Notifications
All
Critical
Warning
Information
Dashboard
Protection
Privacy
Utilities
Notifications
Settings
Infected file det
now
Feature: Antivirus
The file C:\Program
Gen:Variant.Grafto
cleaning process.
View attack tim
Application allow
one minute ago
Application allow
an hour ago
Media autorun i
an hour ago
Application allow
Bitdefender Total Security
setup.exe
driver_boost...
driver_boost...
Threat detected
Alternative outcome
11:58:15
11:58:26
11:58:27
11:59:15
After few seconds

Threat blocked on your device

09/13/24, 11:59:15 | Real-time protection security layer

setup.exe signed by IObit CO., LTD executed driver_booster_setup.exe

Bitdefender offers to explain why it's blocked a possible threat.

Temp cleanup fail

I've noticed that Windows 11 is no longer removing all my temporary files when I use Disk Cleanup or the cleanup options in Settings. The offending files appear to be Windows Updates that refuse to shift, and there are around 8GB of them. Can you help me get rid of them?
Michael A Woods

***APC* Responds:** This sounds like a new 'feature' in the latest version of Windows 11 (Windows 11 24H2) that's been rolling out across PCs. It's linked to a new approach taken by Windows towards implementing updates, which utilises a checkpoint system. This takes recently installed updates and marks them as 'baseline' files. These files allow future cumulative updates to be smaller and faster to install, as they're built from these baselines, rather than the older 24H2 RTM release.

The downside is that these components can't be removed from your PC to free up space in the way they used to be. The problem is compounded by the fact that they show up in Windows' various disk cleanup tools, including DISM and the classic Disk Cleanup tool, as well as Settings' own cleanup manager. As a result, you'll see 8.63GB appear under 'Windows Update Cleanup'. The tools will allow you to select this cache for cleaning, but unfortunately they can't remove it, so it'll keep appearing on future scans.

Microsoft is aware of the problem, and says it'll be issuing a fix. On the upside, although the disk cleanup tools claim the cache is 8.63GB in size, it doesn't appear to take up much drive space. We suspect the tools are inflating the figures, so the fix will likely exclude the cache (and files marked within) from future scans.

Link addy.io to Bitwarden

I recently checked my email at https://haveibeenpwned.com and was shocked – if not exactly surprised – to find it had been exposed in multiple breaches. This has led me to realise that it's time to stop giving out my real email address to all and sundry. I've signed up with addy.io to generate fake email addresses that funnel mail to my actual address, and want to link it to my Bitwarden account. This way, I can easily generate new email usernames alongside strong random passwords directly from Bitwarden when signing up to new sites. Can you explain in simple terms how this is done, please?
Reginald McElfresh

> "Windows 11 is no longer removing all my temporary files when I use Disk Cleanup or the cleanup options in Settings. The offending files appear to be Windows Updates that refuse to shift, and there are around 8GB of them."

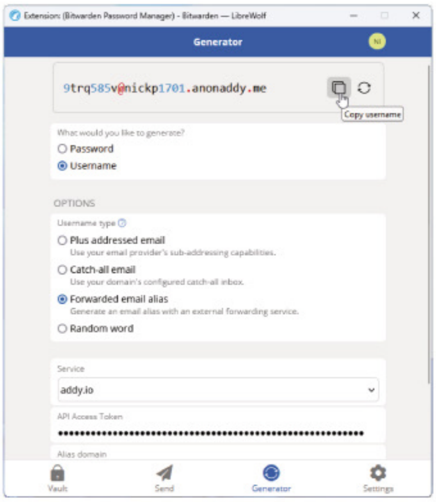
APC Responds: Start by signing into your addy.io account (**https://app.addy.io**) – if you've not already done so, we advise adding 2FA to this account for an extra layer of security. Once done, select Settings from your dashboard, and switch to the API Keys tab, where you'll see a 'Create New API Key' button. Click this to generate a new API key. Give it a suitably descriptive name (Bitwarden being the obvious choice), and choose whether you want the API key to expire after a set date or not (this would mean periodically having to generate a new one). Finally, re-enter your addy.io password, and click 'Create API Key'.

You'll be shown the API key, alongside a QR code – select the code and copy it to the clipboard. Now, switch to Bitwarden and create a Secure Note, inside which you can paste and store the API key (you could also add it as a custom field to your existing addy.io vault entry). You won't be able to view the key from your account again; if you lost it, you'd need to generate a new one.

Once stored in Bitwarden, switch to the Generator section and select Username. Select 'Forwarded email alias' under Options, and 'addy.io' under Service. Paste your API code into the API Access Token field, then fill in the alias domain (it'll be something like yourname@anonaddy.me – check Settings > General tab from your addy.io web dashboard if you're not sure what this is). Leave Server URL blank, then click refresh to generate a new fake email, which will be added to your addy.io account and set to forward to your actual email address. Verify this by checking your addy.io web dashboard, where the fake address should appear.

Bitdefender false positive?

I tried to install IObit Driver Booster on my PC, only for Bitdefender to block the installation. How can I find out more about this? I wasn't aware IObit was linked with malware, so is this a false positive? If it is, how do I stop Bitdefender from blocking the installation?
Natasha M Bell


Extension: (Bitwarden Password Manager) - Bitwarden — LibreWolf
Generator
NI
Copy username
Vault
Send
Generator
Settings

9trq585v@nickp1701.anonaddy.me

What would you like to generate?
○ Password
● Username

OPTIONS

Username type
○ Plus addressed email
Use your email provider's sub-addressing capabilities.
○ Catch-all email
Use your domain's configured catch-all inbox.
● Forwarded email alias
Generate an email alias with an external forwarding service.
○ Random word

Service: addy.io

API Access Token: ••

Alias domain

Use addy.io with Bitwarden to hide your real email address.

APC Responds: The issue here isn't with Driver Booster itself, but one of its components. Thankfully, Bitdefender records plenty of information about threats to help you understand what was blocked and why. To check this, open the Bitdefender window and select Notifications in the left-hand pane. You should see the recent alert appear in the Critical section under 'Infected file detected'. Expand this, and you'll see which file was flagged and the type of threat Bitdefender identified. There's also an attack timeline that provides details of how the attack occurred, and when in the process it was detected and blocked.

The file Bitdefender had identified as being infected in Natasha's case was part of Driver Booster's update mechanism, and it was claimed to be a 'Gen:Variant:Graftor' infection. This indicates that Bitdefender has flagged the file as suspicious based on its behavior rather than any known infection. It's often a false positive – and sure enough, within days, the program installed without flagging an alert.

But just because it's likely to be a false positive, it doesn't mean you should assume it's safe. Bitdefender will allow you to restore flagged items and exclude them from future scans – navigate to Protection, open Antivirus, and switch to Settings to access the quarantine – but it's a good idea to proceed with caution.

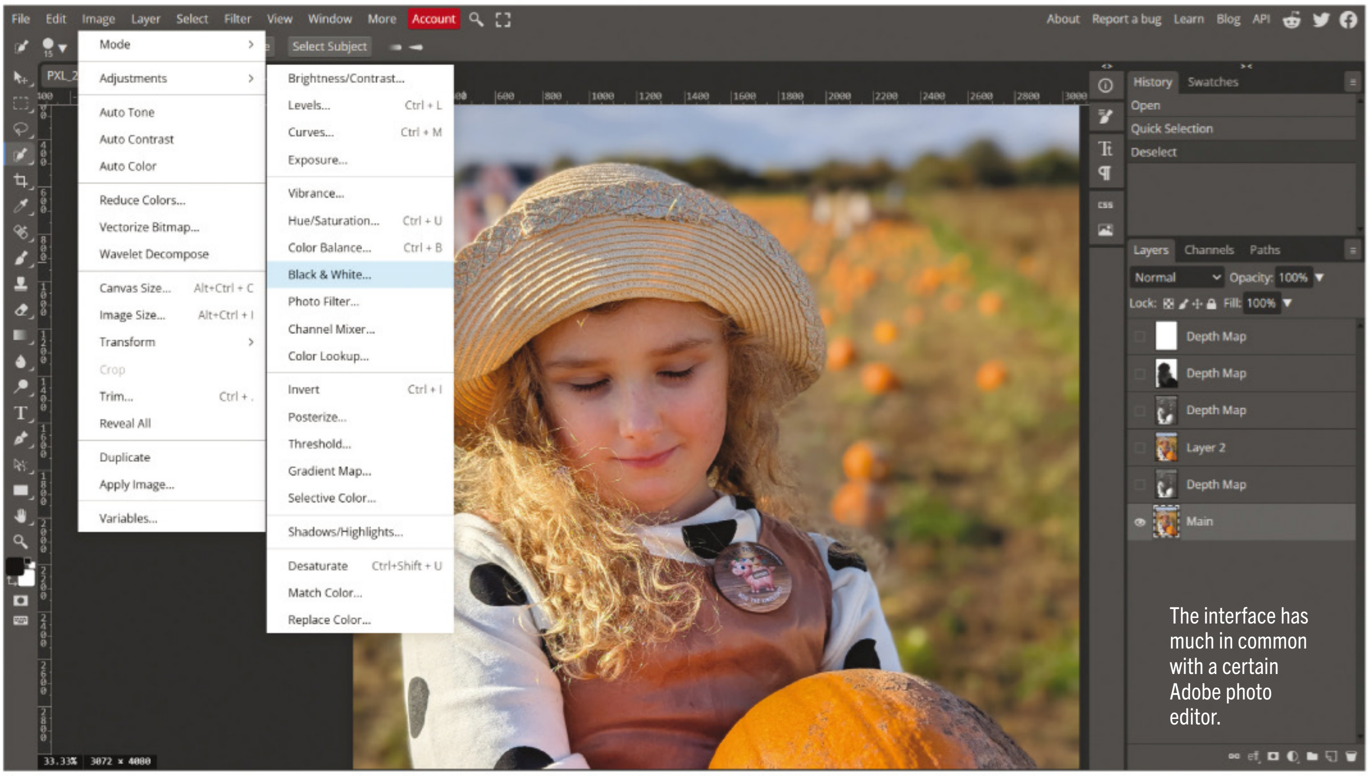
After restoring a file from quarantine, submit it to VirusTotal (**www.virustotal.com/gui/home/upload**) to see how it's viewed by over 70 other antivirus scanners. Also, consider submitting the file to Bitdefender as a false positive – visit **www.bitdefender.com/consumer/support/answer/29358** for full details and a submission form. If it's flagged as clean, the program's virus signatures will be updated, and the file won't be blocked by future scans.

LibreWolf teething problems

I've switched to LibreWolf, as per your recommendation in an issue around the end of 2024, but despite enabling HTML5 Canvas, some sites that worked fine in Firefox refuse to do so in LibreWolf. These are safe – they're my self-hosted web frontends – so what else I can do to get them working properly?
James Salazar

APC Responds: This is likely linked to LibreWolf's Resist Fingerprinting (RFP) protection, which breaks some sites. You can verify this by temporarily disabling the feature via Settings > LibreWolf (uncheck Enable ResistFingerprinting) and refreshing the page. If the site works fine and you're happy for it to bypass RFP protections, the good news is that you can disable RFP on a site-by-site basis, but it requires a bit of extra work.

First, type about:config into the address bar, and hit Enter. Type privacy.resistFingerprinting into the 'Search preference name' box to bring up a list of values. Click the Edit button next to privacy.resistFingerprinting.testGranularityMask, and change its value to 4 before clicking the blue confirm button. Double-click privacy.resistFingerprinting.exemptedDomains, and enter any domain or IP address you wish to exclude from the checks (separate multiple entries with a comma). Once you've clicked the blue apply button, the sites should now work correctly again, while other sites remain subject to RFP protections. ■


File
Edit
Image
Layer
Select
Filter
View
Window
More
Account
About
Report a bug
Learn
Blog
API
Select Subject
Mode
Adjustments
Auto Tone
Auto Contrast
Auto Color
Reduce Colors...
Vectorize Bitmap...
Wavelet Decompose
Canvas Size... Alt+Ctrl+C
Image Size... Alt+Ctrl+I
Transform
Crop
Trim... Ctrl+.
Reveal All
Duplicate
Apply Image...
Variables...
Brightness/Contrast...
Levels... Ctrl+L
Curves... Ctrl+M
Exposure...
Vibrance...
Hue/Saturation... Ctrl+U
Color Balance... Ctrl+B
Black & White...
Photo Filter...
Channel Mixer...
Color Lookup...
Invert Ctrl+I
Posterize...
Threshold...
Gradient Map...
Selective Color...
Shadows/Highlights...
Desaturate Ctrl+Shift+U
Match Color...
Replace Color...
History
Swatches
Open
Quick Selection
Deselect
Layers
Channels
Paths
Normal
Opacity: 100%
Lock:
Fill: 100%
Depth Map
Depth Map
Depth Map
Layer 2
Depth Map
Main
33.33%
3072 × 4080

The interface has much in common with a certain Adobe photo editor.

Instant expert: Photopea

Touch up and transform images on any device, with nothing to install – Nik Rawlinson dives into the browser-based image editor.

If you want to edit and enhance your photos, you don't need to install a weighty app – you can do it right in your web browser. One way is to use Adobe's online version of Photoshop (tinyurl.com/APC541photo), but this requires a full-price Photoshop subscription, making it uneconomical for casual use.

A great alternative is Photopea (**photopea.com**). This browser-based image editor offers a versatile, professional-grade editing environment with support for a wide range of file formats – and its interface will be immediately familiar to anyone who's used Photoshop or other serious image-editing software in the past. Best of all, if you don't mind seeing a few ads, you can use all its built-in features free. Here's everything you need to know to make the most of this powerful online tool.

What does it cost?

Anyone can sign up to Photopea and start using it for free – you don't even need to create an account. The only catch is that a permanent ad panel will be displayed at the side of the browser window, reducing your available working space.

You can remove this panel by upgrading to a Premium subscription, which starts at US$8 per month for a single user, US$15 for 90 days, and US$50 for a year. As well as removing adverts, a subscription comes with 3,000 credits per month for using the various generative AI tools that are built into Photopea, which we'll discuss below.

For businesses, Photopea offers team plans for five, 20 and 50 seats. These are priced on a sliding scale, so kitting out a team of 20 for the year costs US$500, but for 50 it's only US$999. Organisations can embed Photopea within their own domain, or even host it on their own server, to ensure it remains available should their connection to the outside world go down.

If that appeals, you'll need to talk to Photopea directly to get a price, and pay for 12 months up front. The fee includes two updates a year, with additional updates available for an extra US$300 if you choose to implement them.

How do I access Photopea?

Assuming you're not hosting it on your own network or server, you'll find Photopea at photopea.com. You don't need to download anything: the app runs entirely in your browser, and works on both desktop and mobile platforms. Slightly confusingly, you'll see a link on the welcome page inviting you to "Install Photopea", which installs a shortcut to allow quick access to the program in a mode with minimal browser furniture. This makes Photopea look and work more like a desktop application, but the editor itself still runs in the cloud. You can alternatively switch Photopea to full-screen mode by clicking the icon at the far right of the menu bar.

If you're worried about what Photopea's online model implies for data security and privacy, you needn't be. All the actual editing is performed on your own machine, using your own processor and GPU; unless you use the program's outsourced AI features, your images are never uploaded to Photopea's servers or anywhere else.

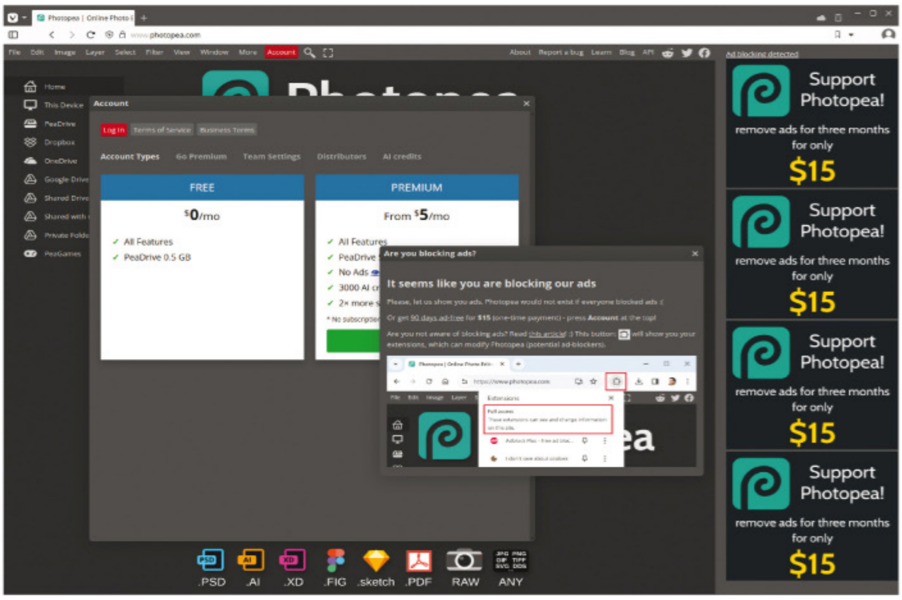
How does Photopea fit into my existing workflow?

Photopea uses industry-standard file formats, so you can work with your existing assets without having to convert and export them. This doesn't just mean JPEGs and PNGs: Photopea natively loads and saves in the PSD format as used by Adobe Photoshop, and can also read Illustrator, InDesign, Affinity Photo and Sketch files. It can open and edit raw camera files, too (including the platform-agnostic digital negative format), and even animations including MP4, WebM and animated GIFs.

Third-party files don't always import perfectly. We tried loading an InDesign file, and although Photopea got the layout right, with clearly labelled artboards, pages and layers, the copy didn't flow correctly from one frame to the next. Still, we were able to move elements about and extract the full text, which could be a very useful capability if you need to access a file and don't have the original Adobe application.

Connecting to cloud storage

As soon as the Photopea website appears in your browser you can start importing and editing files; free users don't even need to log in. However, when starting out you might want to link a cloud storage service to Photopea, for convenient access to your files. You'll find options for connecting to Dropbox, Google Drive and OneDrive in the sidebar, or you can use Photopea's own PeaDrive, which provides 500MB of storage for free users or 5GB for premium accounts. If you prefer not to use cloud storage, you can store your work locally by clicking "This Device" in the sidebar, or simply selecting "New Project" from the main part of the screen.


Photopea | Online Photo E
www.photopea.com
File
Edit
Image
Layer
Select
Filter
View
Window
More
Account
About
Report a bug
Learn
Blog
API
Ad blocking detected
Home
This Device
PeaDrive
Dropbox
OneDrive
Google Drive
Shared Drive
Shared with
Private Folder
PeaGames
Account
Log In
Terms of Service
Business Terms
Account Types
Go Premium
Team Settings
Distributors
AI credits
FREE
$0/mo
✓ All Features
✓ PeaDrive 0.5 GB
PREMIUM
From $5/mo
✓ All Features
✓ PeaDrive
✓ No Ads
✓ 3000 AI cr
✓ 2× more
* No subscription
Are you blocking ads?
Extensions
Full access
.PSD
.AI
.XD
.FIG
.sketch
.PDF
RAW
ANY
Support Photopea!
remove ads for three months for only
$15
Support Photopea!
remove ads for three months for only
$15
Support Photopea!
remove ads for three months for only
$15
Support Photopea!
remove ads for three months for only
$15

It seems like you are blocking our ads

Please, let us show you ads. Photopea would not exist if everyone blocked ads :(

Or get 90 days ad-free for $15 (one-time payment) - press Account at the top!

Are you not aware of blocking ads? Read this article! :) This button: will show you your extensions, which can modify Photopea (potential ad-blockers).

If you try to block Photopea's ads, you'll just see placeholders instead.

> "You've nothing to lose by trying it out as an alternative to Photoshop"

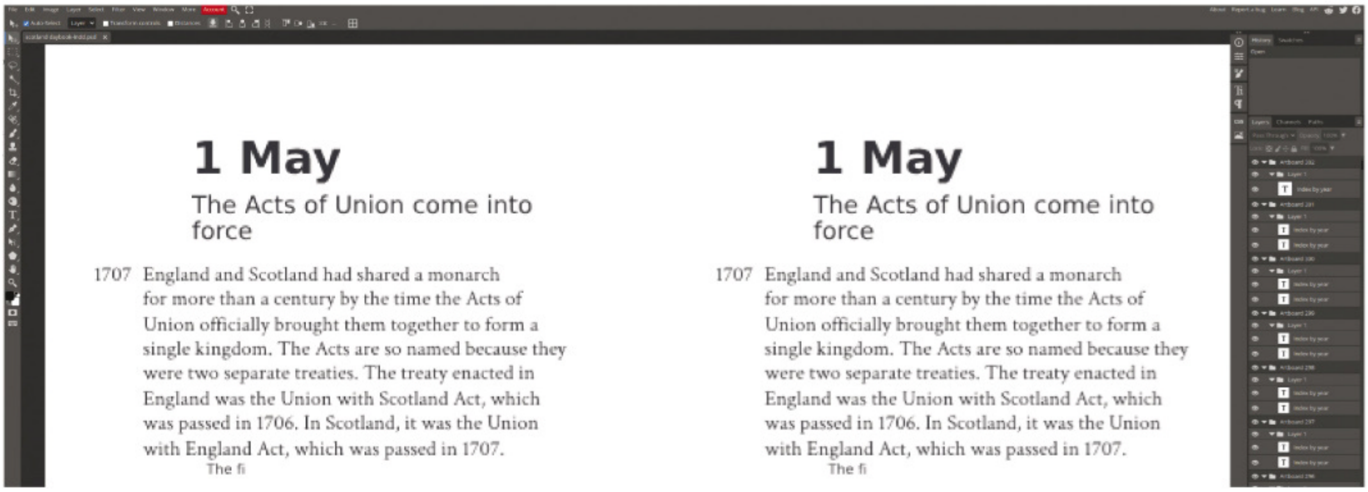
Existing images can be opened by dragging them into the application; dragging in an image when you already have a file open adds it on a new layer. Anything you import is automatically converted into PSD format for editing, including other file types such as InDesign layouts.

Make frame-wide adjustments

One common photo-editing task is to adjust the overall tone or colouring of an image. You can do this from the Adjustments fly-out on the Image menu: here, you'll find all the editing tools you would expect, including curves, shadows and highlights, brightness/contrast and colour balance. There's also a powerful black-and-white adjustment tool, much like the one in Photoshop, which lets you rebalance the intensity of each channel within the original image.

If you want to tweak your edits later, or to apply them only to a certain part of the image, you can create adjustment layers by clicking the New Adjustment Layer button at the bottom of the Layers panel (it looks like a half-moon). An adjustment layer behaves like a lens through which you're viewing the visible layers below; it's ideal for non-destructively trying out different settings without modifying the original image. You can stack multiple adjustment layers and change their order, and adjust the opacity of individual layers to tone down effects that look too stark.

Most powerfully, all adjustment layers



1 May

The Acts of Union come into force

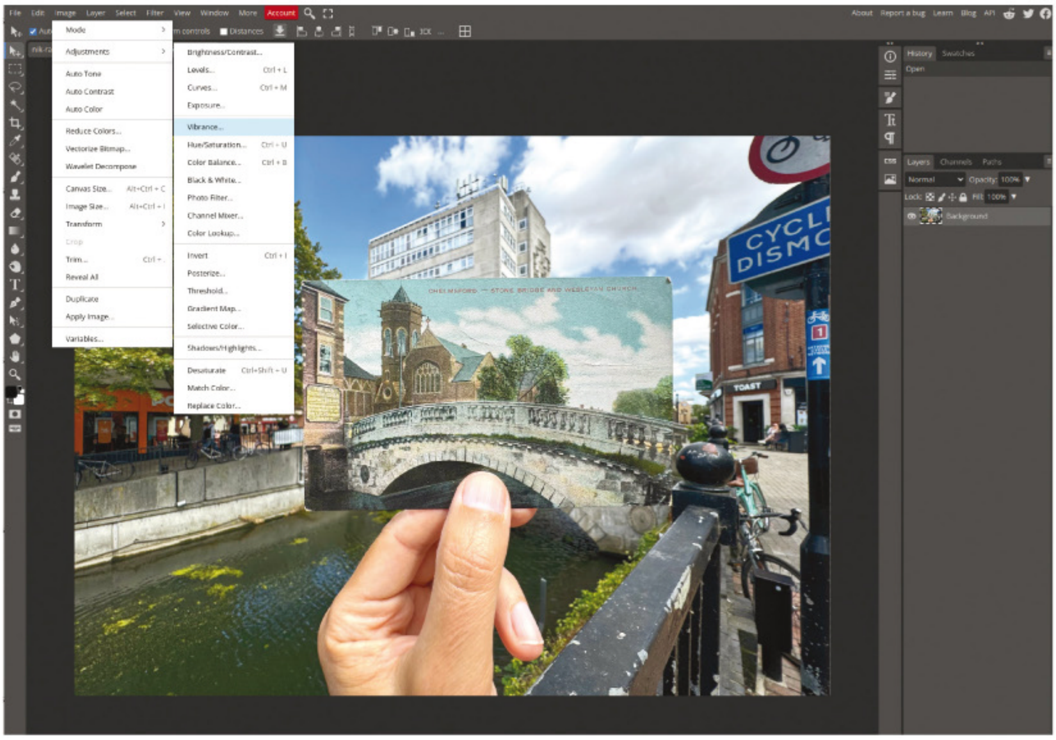
1707 England and Scotland had shared a monarch for more than a century by the time the Acts of Union officially brought them together to form a single kingdom. The Acts are so named because they were two separate treaties. The treaty enacted in England was the Union with Scotland Act, which was passed in 1706. In Scotland, it was the Union with England Act, which was passed in 1707.
The fi

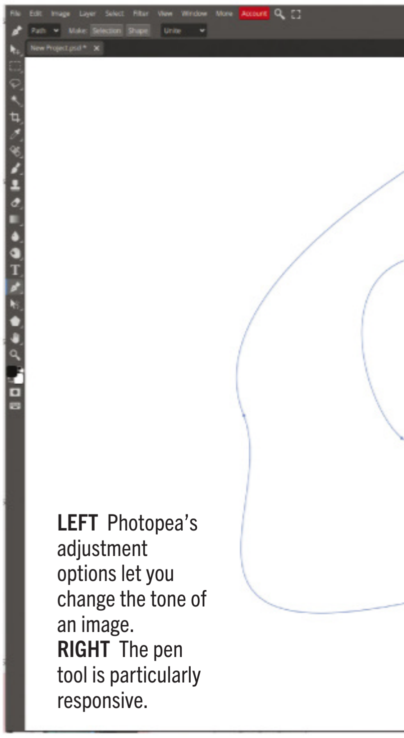
1 May

The Acts of Union come into force

1707 England and Scotland had shared a monarch for more than a century by the time the Acts of Union officially brought them together to form a single kingdom. The Acts are so named because they were two separate treaties. The treaty enacted in England was the Union with Scotland Act, which was passed in 1706. In Scotland, it was the Union with England Act, which was passed in 1707.
The fi

Our InDesign file wasn't imported perfectly, but Photopea is still a powerful tool.


File
Edit
Image
Layer
Select
Filter
View
Window
More
Account
Mode
Adjustments
Auto Tone
Auto Contrast
Auto Color
Reduce Colors...
Vectorize Bitmap...
Wavelet Decompose
Canvas Size...
Image Size...
Transform
Crop
Trim...
Reveal All
Duplicate
Apply Image...
Variables...
Brightness/Contrast...
Levels...
Curves...
Exposure...
Vibrance...
Hue/Saturation...
Color Balance...
Black & White...
Photo Filter...
Channel Mixer...
Color Lookup...
Invert
Posterize...
Threshold...
Gradient Map...
Selective Color...
Shadows/Highlights...
Desaturate
Match Color...
Replace Color...
History
Swatches
Layers
Channels
Paths
Background



LEFT Photopea's adjustment options let you change the tone of an image.
RIGHT The pen tool is particularly responsive.

are created with a mask, which you can edit to make your adjustments apply only in specified areas of the image. Any area of the mask that you colour black (using Photopea's drawing or adjustment tools) will become transparent, meaning that part of the adjustment layer has no effect on the pixels below. You can also create areas of different opacities by painting in different shades of grey.

> "Even if you already use Photoshop, Photopea's ability to open and save PSD files makes it a convenient companion app for trying out ideas or making quick changes when you're away from your main computer."

Focus on the details

Adjustment layers are great for broad corrections, but directly editing the content of an image requires a more hands-on approach. Photopea's toolbox will again be familiar to anyone switching from Photoshop, as will be many of the shortcuts for switching between its tools: press P for pen, B for brush, C for crop and so on.

These drawing and editing tools take effect in real-time. For example, if you're "painting" with the blur tool you'll instantly see the image soften as you stroke the layer. The same is true of the dodge and burn tools, which occupy the same toolbox button, along with the sponge tool. As is common across many image-editing suites, long-holding on a button opens the fly-out to reveal its alternative functions.

You can use all of these tools with a mouse, a touchpad, a touchscreen or a stylus; if your input device supports pressure detection, you can set Photopea to change either the opacity of your drawing or the brush size according to how hard you're pushing down. We tried this on an iPad with an Apple Pencil and found it a very natural and intuitive way to work.

API AND SCRIPTING

Alongside its extensive in-browser editing capabilities, Photopea offers a powerful API for remote access and configuration. You can configure its settings and environment variables from a browser or a script simply by accessing the main URL, followed by a hash symbol and a valid stream of data in JSON format – see **photopea.com/api** for more about what you can do.

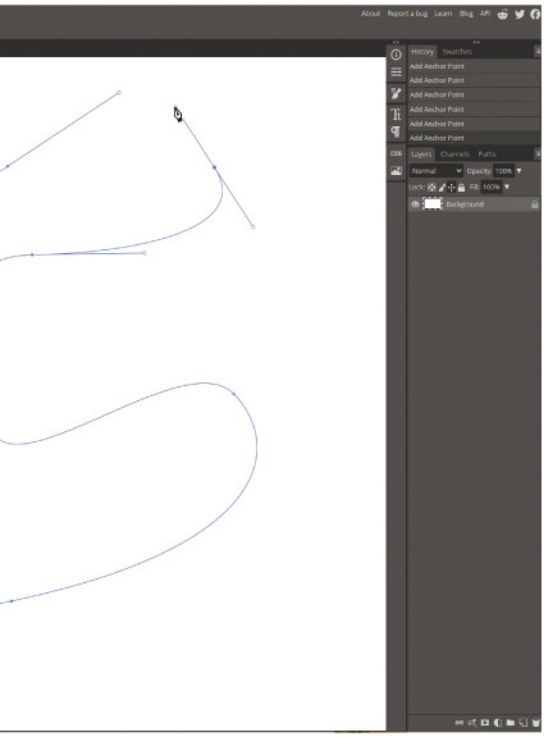
What's more, almost every feature of Photopea can be remotely accessed and controlled in JavaScript, again passed via the web API. This allows you to use Photopea as the basis for your own batch-editing or processing routine. API access is free and unlimited, even if you're not a subscriber, and since the syntax is almost identical to that of Adobe's scripting interface for Photoshop, you can use imported scripts with little or no modification required. See **photopea.com/learn/scripts** for a guide to how it works.

Work with vectors

Photographs are, by nature, raster images, but Photopea also lets you add vector objects and layers to your file. The Shape tool in the toolbox can be used to create common shapes such as stars, polygons and arrows; if you want something more complex, the pen tool lets you design your own shapes using a closed loop of Bézier curves. Photopea is terrifically responsive when working with the pen tool in this way, and lets you quickly and intuitively refine your shape by grabbing and repositioning its handles.

Manage your layers

Layers aren't just for adjustments, or for separating raster and vector objects. They can be a powerful productivity feature, allowing you to separate and stack the different elements of your image, so you


About
Report a bug
Learn
Blog
API
History
Swatches
Add Anchor Point
Add Anchor Point
Add Anchor Point
Add Anchor Point
Add Anchor Point
Add Anchor Point
Add Anchor Point
Layers
Channels
Paths
Normal
Opacity: 100%
Fill: 100%
Background

can individually transform and edit them. If you're working with a flat image, there are tools on hand to help you move elements onto different layers: the Select | Subject tool automatically selects foreground objects, which you can copy and paste onto a new layer. The AI-powered Select | Remove BG does the opposite, automatically removing the background from a layer (see "AI in Photopea", right).

If these tools don't get it quite right, you can use the Magic Cut feature to manually highlight which parts of the image you want to include and exclude, with a live preview that lets you refine the selection until it's perfect.

Working with layers doesn't have to mean continually flipping up and down through the stack. At the bottom of the Layers palette, you'll find a set of controls that allow you to group layers or place them into folders. This allows you to easily adjust settings such as opacity and blend modes for multiple elements at once – or show and hide them all together. There's also a button for applying visual styles to one or multiple layers, with options including outlines, drop shadows and more.

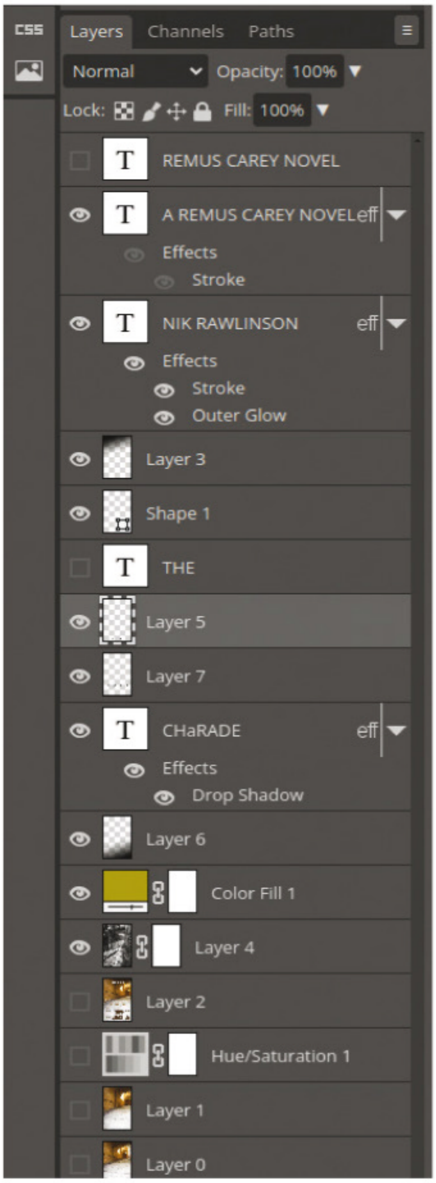
Perhaps the most powerful layer style in Photopea is the one that controls blending, with options for blend mode, opacity and fill. Through this style you can access the "Blend if" control, which sets the current layer – or aspects of the current layer – to be visible or hidden depending on the intensity of its own red, green, blue or grey levels, or those of the background layer.

Save and share your work

Whether you're using Photopea to edit existing images or to create something original, you'll eventually want to save your work. We've mentioned that Photopea uses PSD as its native file format, so this is the best choice for ongoing projects. If you want to share your work or upload it to social media, you can export flat files in JPEG or PNG format – or, if it's a vector image, you can save it as a SVG or PDF file.

By default, Photopea saves files to your local hard disk, but selecting "PSD to Storage" will open a more extensive in-app file-saving dialog, with direct access to Dropbox, Google Drive, OneDrive and PeaDrive. If you want to use one of these services but didn't grant access to Photopea when you first started using the suite, you can authorise it at this point.

Since Photopea doesn't lock you into any proprietary workflow or file format, you've nothing to lose by trying it out as an alternative to a costly Photoshop subscription. In fact, even if you already use Photoshop, Photopea's ability to open and save PSD files makes it a convenient companion app for trying out ideas or making quick changes when you're away from your main computer.
It can also be a cost-effective tool for a business, giving employees who don't require a full offline editing setup an easy way to collaborate with colleagues using Creative Cloud or other design tools. ■


CSS
Layers
Channels
Paths
Normal
Opacity: 100%
Lock:
Fill: 100%
REMUS CAREY NOVEL
A REMUS CAREY NOVEL
eff
Effects
Stroke
NIK RAWLINSON
eff
Effects
Stroke
Outer Glow
Layer 3
Shape 1
THE
Layer 5
Layer 7
CHaRADE
eff
Effects
Drop Shadow
Layer 6
Color Fill 1
Layer 4
Layer 2
Hue/Saturation 1
Layer 1
Layer 0

Layers let you keep your work organised and apply adjustments.

AI IN PHOTOPEA

You might be fed up of hearing about AI, but image editing is an area where it can be enormously helpful. We've mentioned the AI-assisted Remove BG tool, which does a spookily intelligent job of separating foreground and background objects; Photopea also uses generative AI for its Magic Replace tool, which can transform and add new elements to an image based on your text prompt.

Unfortunately, as we all know, AI is expensive to operate, so free users are only allowed to use Remove BG once per day without interruption. If you want to use it again within 24 hours you have to watch a short video advertisement first, while Magic Replace requires watching two ads in a row. It's a distraction, but the ads aren't too intrusive (we've found they're generally between five and 20 seconds long) and the results are very good.

Premium subscribers won't normally have to worry about ads: they get 3,000 credits a month, with each use of Remove BG costing one credit and Magic Replace costing three credits. If you run out of credits you can create and link your own account at Dezgo (the back-end platform that powers Photopea's AI features), and pay as you go for as many operations as you like. Just be aware that these AI features require your image to be shared with Dezgo, meaning they're not as perfectly private as the rest of Photopea.

Remove bloatware from Windows

It's tidy time, with Nate Drake.

YOU'LL NEED

- CCleaner Optional, download it from www.ccleaner.com
- A stable internet connection

***APC* readers will know that nothing quite compares to the glee of firing up a brand new laptop or computer for the first time. Unfortunately, your excitement can easily be dampened by the presence of 'bloatware'. This is software that usually comes bundled with Windows, and provides no significant value to the user.**

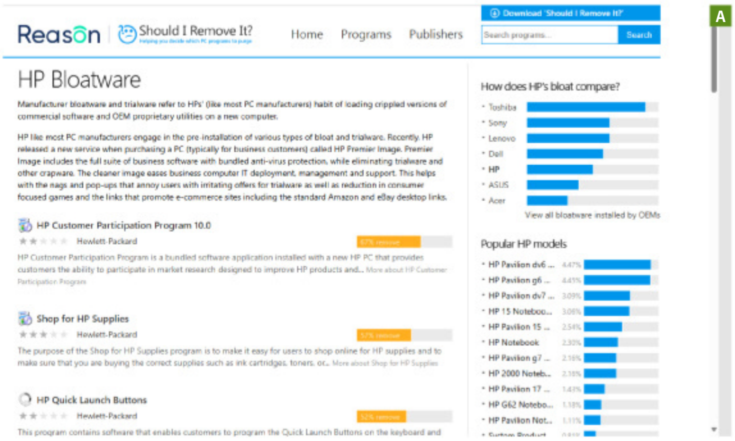
Common culprits included third-party antivirus and media software. As Windows veterans know, these programs may offer a free trial, and even work unobtrusively for a short period of time. However, at the end of the trial period, users are usually plagued with pop-ups encouraging them to register and/or subscribe.

Bloatware, by definition, is software that is unnecessary to the smooth running of the OS. The more bloatware you have, the greater the drain on your system resources, particularly during startup. Unnecessary programs are also an extra drain on the battery of portable devices.

Even if you have a PC with plenty of RAM and storage to spare, having unknown programs on your machine is a bad idea. Bloatware can interfere with the running of legitimate Windows software. Given that most bloatware is proprietary, there may also be security bugs. In this guide, we'll explore ways both to reduce your attack surface and free up resources by identifying, then removing, bloatware from your device.

Identify bloatware

Bloatware is a many-headed beast. One of the most common forms is 'junkware' – software for activities like listening to music or to forecast the weather. There are usually better ways to do this using Windows' built-in features or free and open-source alternatives.


Reasōn
Should I Remove It?
Helping you decide which PC programs to purge
Home
Programs
Publishers
Download 'Should I Remove It?'
Search programs...
Search
How does HP's bloat compare?
Toshiba
Sony
Lenovo
Dell
HP
ASUS
Acer
View all bloatware installed by OEMs
Popular HP models
HP Pavilion dv6 ... 4.47%
HP Pavilion g6 ... 4.45%
HP Pavilion dv7 ... 3.09%
HP 15 Noteboo... 3.06%
HP Pavilion 15 ... 2.54%
HP Notebook 2.30%
HP Pavilion g7 ... 2.16%
HP 2000 Noteb... 2.15%
HP Pavilion 17 ... 1.43%
HP G62 Notebo... 1.18%
HP Pavilion Not... 1.11%
A

HP Bloatware

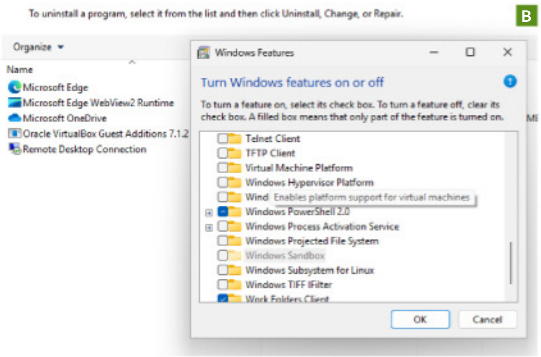
Manufacturer bloatware and trialware refer to HPs' (like most PC manufacturers) habit of loading crippled versions of commercial software and OEM proprietary utilities on a new computer.

HP like most PC manufacturers engage in the pre-installation of various types of bloat and trialware. Recently, HP released a new service when purchasing a PC (typically for business customers) called HP Premier Image. Premier Image includes the full suite of business software with bundled anti-virus protection, while eliminating trialware and other crapware. The cleaner image eases business computer IT deployment, management and support. This helps with the nags and pop-ups that annoy users with irritating offers for trialware as well as reduction in consumer focused games and the links that promote e-commerce sites including the standard Amazon and eBay desktop links.

HP Customer Participation Program 10.0
Hewlett-Packard
HP Customer Participation Program is a bundled software application installed with a new HP PC that provides customers the ability to participate in market research designed to improve HP products and... More about HP Customer Participation Program

Shop for HP Supplies
Hewlett-Packard
The purpose of the Shop for HP Supplies program is to make it easy for users to shop online for HP supplies and to make sure that you are buying the correct supplies such as ink cartridges, toners, or... More about Shop for HP Supplies

HP Quick Launch Buttons
Hewlett-Packard
This program contains software that enables customers to program the Quick Launch Buttons on the keyboard and


B
Organize
Name
Microsoft Edge
Microsoft Edge WebView2 Runtime
Microsoft OneDrive
Oracle VirtualBox Guest Additions 7.1.2
Remote Desktop Connection
Windows Features
OK
Cancel

To uninstall a program, select it from the list and then click Uninstall, Change, or Repair.

Turn Windows features on or off

To turn a feature on, select its check box. To turn a feature off, clear its check box. A filled box means that only part of the feature is turned on.

☐ Telnet Client
☐ TFTP Client
☐ Virtual Machine Platform
☐ Windows Hypervisor Platform
☐ Wind Enables platform support for virtual machines
■ Windows PowerShell 2.0
☐ Windows Process Activation Service
☐ Windows Projected File System
☐ Windows Sandbox
☐ Windows Subsystem for Linux
☐ Windows TIFF IFilter
☑ Work Folders Client

Trialware is also a form of bloatware. This includes software like antivirus programs, which functions well enough for a set time. However, at the end of the trial, these forms of bloatware tend to aggressively remind the user to purchase a subscription to continue to benefit from its features.

Some bloatware, like adware, is much more blatant, displaying pop-ups for a particular product or service, even when you're using legitimate programs, like your web browser.

Unnecessary toolbars and browser extensions can also be bloatware. They can slow down your connection and even present security risks if they share your data without your consent.

Readers will note that we haven't written out a grocery list of apps to remove from your Windows PC. This is because bloatware is defined by its behavior. The closest you can get are websites like 'Should I Remove It?' (**www.shouldiremoveit.com**), which list common applications that people remove **[Image A]**.

For instance, upon visiting the 'Programs' section of the site, we discovered that 29 percent of polled users removed 'HP Update'. This is a legitimate program for checking and downloading updates, and comes preinstalled on many HP machines. While it's clearly convenient, you can always remove and run updates manually.

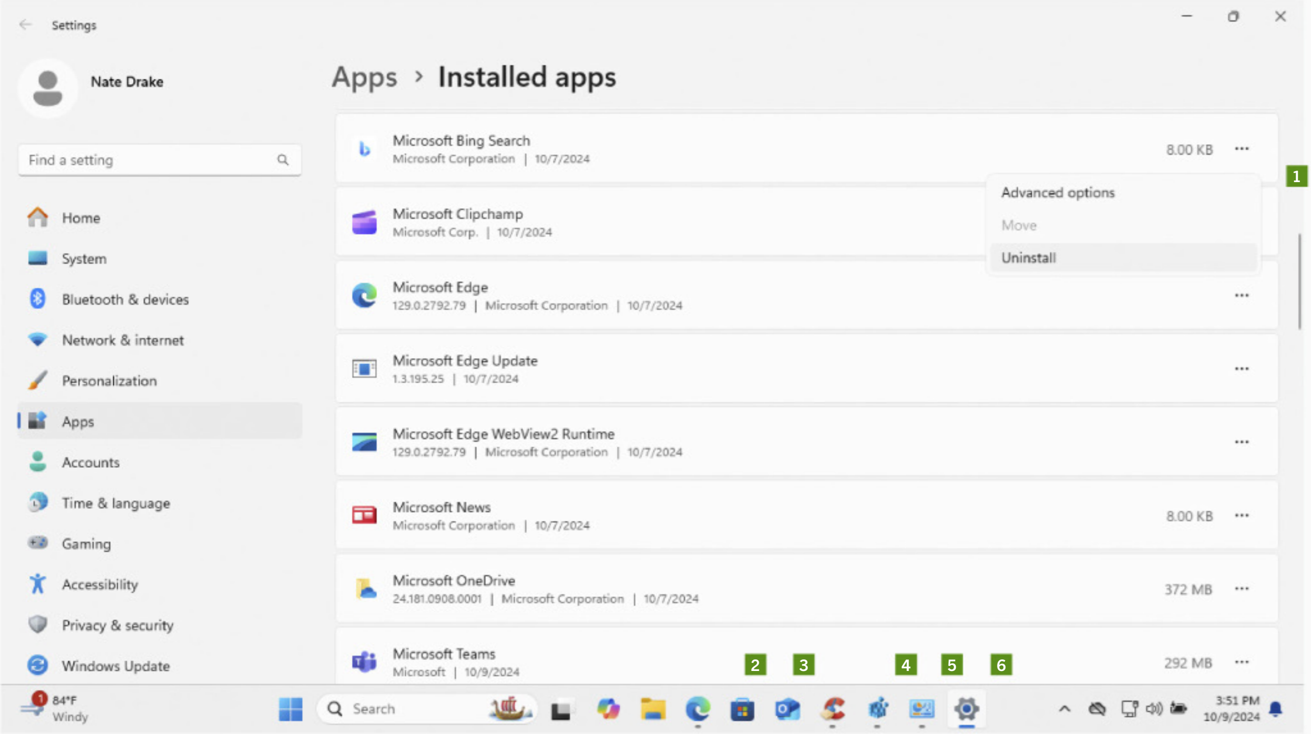
The website also has dedicated sections listing common bloatware for certain types of machines. The HP section, for example, lists programs like 'HP Customer Participation'.

We recommend running a full system backup before proceeding with the following steps, just in case you accidentally remove any important software.

Remove programs via Settings

To see which programs you currently have installed, enter 'programs' into the Windows search bar to launch 'Add or remove programs'.

A Bloatware-Free System


Settings
Nate Drake
Find a setting
Home
System
Bluetooth & devices
Network & internet
Personalization
Apps
Accounts
Time & language
Gaming
Accessibility
Privacy & security
Windows Update
Apps > Installed apps
Microsoft Bing Search
Microsoft Corporation | 10/7/2024
8.00 KB
Advanced options
Move
Uninstall
Microsoft Clipchamp
Microsoft Corp. | 10/7/2024
Microsoft Edge
129.0.2792.79 | Microsoft Corporation | 10/7/2024
Microsoft Edge Update
1.3.195.25 | 10/7/2024
Microsoft Edge WebView2 Runtime
129.0.2792.79 | Microsoft Corporation | 10/7/2024
Microsoft News
Microsoft Corporation | 10/7/2024
8.00 KB
Microsoft OneDrive
24.181.0908.0001 | Microsoft Corporation | 10/7/2024
372 MB
Microsoft Teams
Microsoft | 10/9/2024
292 MB
1
2
3
4
5
6
84°F
Windy
Search
3:51 PM
10/9/2024

1 App settings

Most applications can be removed via Windows settings, unless they form a core part of the operating system, like Edge. Some Microsoft programs, like Clipchamp, can be uninstalled here.

2 Browser bloatware

Web browsers don't often come with bloatware, but users can sometimes install redundant extensions, like multiple adblockers. Edge also collects data to make personalised suggestions, though you can disable this.

3 Microsoft Store

Although you can no longer remove applications from here, Windows can be configured only to allow installation of software from the Microsoft Store. This reduces the chance of accidentally installing bloatware.

4 CCleaner

This useful (and free) utility has multiple features for removing bloatware. These include deleting a broader range of Microsoft apps, as well as scanning the registry for obsolete software entries.

5 Registry Editor

An important tool in beating bloatware, the Registry can hide entries for startup apps not listed in Windows settings. Check settings for your account and the 'Local Machine' for these.

6 Control Panel

This has a function for removing third-party programs. You can also view and disable Windows features like VMP to improve system performance.

Take the time to scroll through this list and compare the listed apps with a reputable database such as "Should I Remove It?"

This is a worthwhile activity, even if you performed a clean install of Windows 11 yourself, as there are a number of Microsoft apps that you may not use. In the case of our virtual machine, for instance, we successfully removed both Microsoft Bing Search and Microsoft News.

You can also uninstall Microsoft 'Quick Assist' and 'Remote Desktop Connection' safely, provided that you don't need to use the screen-sharing feature.

In each case, removing an app is as simple as clicking the ... next to the program name, then choosing 'uninstall'. If you think you may need to use a feature like 'Quick Assist' in the future, instead of uninstalling, choose 'Advanced options'.

In the 'Background app permissions' section, change the drop-down menu to 'Never'. Next, scroll down and click 'Terminate' to end the current process. Moving forward, the program won't consume any system resources unless you enable it manually, or if it's configured to launch upon startup.

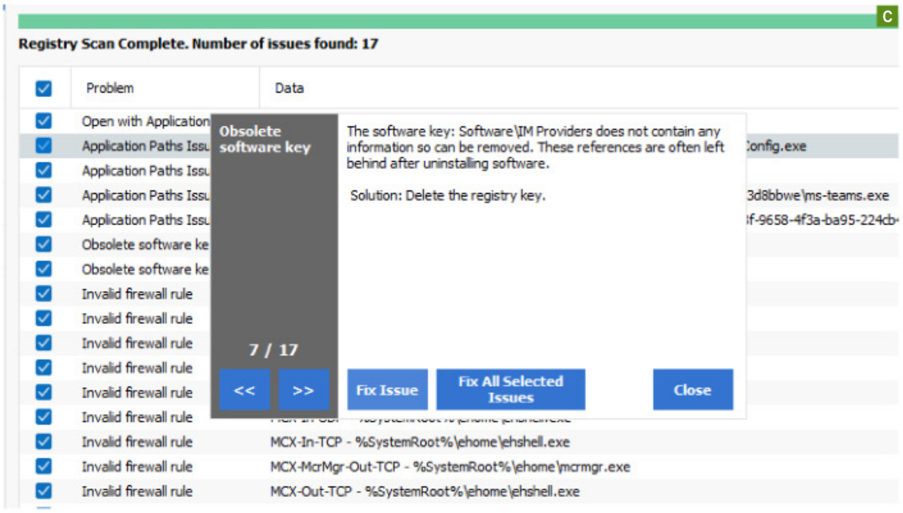
Once you've worked through the list of programs, click into the 'Apps' category at the top of the screen, and choose 'Advanced app settings'.

By default, the drop-down for 'Choose where to get apps' is set to 'Anywhere'. As an experienced user, you'll probably want to leave this as it is. However, if you're following this tutorial to clear bloatware from a friend or family member's PC, change this to 'The Microsoft store only'. This means there's less chance that your loved one will install junkware directly from the internet in future.

Next, double-check that 'Archive apps' is enabled. This very useful Windows feature ensures that apps you don't use regularly are archived to save both space and bandwidth. If you do choose to launch an archived app, the full version will automatically be restored, along with any user data.

Control and clean

Although Windows Settings offers an easy way to view and remove installed apps, you can also do so via the Control Panel **[Image B]**. This is a good way to examine legacy programs.



Registry Scan Complete. Number of issues found: 17

Obsolete software key

The software key: Software\IM Providers does not contain any information so can be removed. These references are often left behind after uninstalling software.

Solution: Delete the registry key.

Problem
Data
Open with Application
Application Paths Issu
Application Paths Issu
Application Paths Issu
Application Paths Issu
Obsolete software ke
Obsolete software ke
Invalid firewall rule
Invalid firewall rule
Invalid firewall rule
Invalid firewall rule
Invalid firewall rule
Invalid firewall rule
Invalid firewall rule
Invalid firewall rule
Invalid firewall rule
'onfig.exe
3d8bbwe\ms-teams.exe
f-9658-4f3a-ba95-224cb
MCX-In-TCP - %SystemRoot%\ehome\ehshell.exe
MCX-McrMgr-Out-TCP - %SystemRoot%\ehome\mcrmgr.exe
MCX-Out-TCP - %SystemRoot%\ehome\ehshell.exe
7 / 17
<<
>>
Fix Issue
Fix All Selected Issues
Close

To get started, launch the Control Panel and choose 'Uninstall a program'. Right-click an app to 'Uninstall'. As with Windows' app settings, you cannot remove any applications like Edge, which form a core part of the OS.

Once you've removed any unneeded apps, select 'Turn Windows features on or off'. These aren't bloatware, but disabling unnecessary features can improve system performance.

For example, VMP (Virtual Machine Platform) provides core virtual machine services in Windows. According to Microsoft's support documentation, this can impact gaming performance. Disable features by unchecking the corresponding tick box. Once this is done, restart your device to implement the changes.

If you're having trouble uninstalling a third-party app via either Windows Settings or Control Panel, open the Microsoft Store, and install CCleaner.

This utility is not bloatware – it can be used to remove leftover files and registry entries when the usual uninstall methods don't work. Upon launch, choose to 'Run your first scan'. Save and close any running programs so they can be scanned as well.

Once the scan is complete, choose 'Tools' from the left-hand pane, then 'Uninstall' at the top left. CCleaner will now list any remaining programs.

One major advantage of using CCleaner is that it has a more flexible approach to the programs it can delete. For instance, although App settings doesn't allow you to remove Windows programs, we were able to remove the system calculator and Xbox Game Bar using the utility.

There are two options for app removal. The first ('Uninstall') will simply run the program's own uninstaller.

You can also choose 'Delete'. This removes the uninstall entry without deleting the program. This is useful when an application has been uninstalled, but is still listed in App Settings.

Powering up

Back in Step 1, we admitted that we didn't have a 'grocery list' of bloatware that users should uninstall.

We've left this to others like developer Raphire, the creator of 'Win11Debloat'. This PowerShell script is designed to remove preinstalled Windows bloatware apps like Microsoft Journal. It also can remove certain third-party programs, like 'WinZipUniversal'.

You can view the full list of supposed bloatware apps and the Win11Debloat script itself from **https://github.com/Raphire/Win11Debloat**.

The quickest way to get started is to enter 'powershell' into the Windows search bar, then right-click to 'Run as administrator'.

Next, enter the following command to download and launch the script:

```
& ([scriptblock]::Create((irm "https://win11debloat.raphi.re/")))
```

The utility will be downloaded, then launch in another window. The main menu lists three options. Choose '2' to customise the script to your needs.

From here, you can just choose to remove the default selection of apps listed on the Github page (option 1). Win11Debloat can also remove other programs, like calendar and developer apps (option 2).

If you prefer to have some say in what's removed, choose option 3. This will launch a pop-up window where you can check apps to remove. Read through the list carefully, as not all of these are

TINY VICTORIES

If you've followed this guide, you'll see that when it comes to bloatware, Microsoft itself is one of the main culprits.

The development team at NTDEV have offered a solution: Tiny11, a stripped-down version of Windows 11. Its main purpose is to offer a less resource-hungry OS – the install footprint is only 8GB, compared to around 20GB for stock Windows.

However, as the developer page for their custom script (**https://github.com/ntdevlabs/tiny11builder**) states, Tiny11 also eliminates most bloatware, like Clipchamp and Weather.

Tiny11 ISOs are available from sites like the Internet Archive. The developers recommend using the 'tiny11builder' PowerShell script on a recent version of Windows for an up-to-date custom ISO.

Download a recent version of Windows 11 from the Microsoft site. Next, right-click the ISO, and choose to 'Mount' in Windows Explorer.

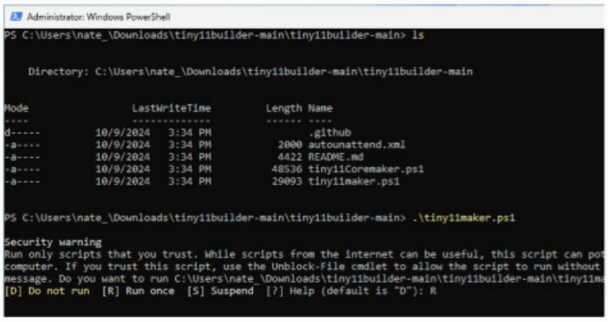
Open PowerShell as Administrator and ensure you can run the script with:

```
Set-ExecutionPolicy unrestricted
```

Download the Tiny11 builder files from the link above, and use 'cd' to change to the folder location. You can execute the .ps1 file with:

```
.\tiny11maker.ps1
```

Enter the drive letter of the Windows 11 ISO you mounted earlier to proceed.



Administrator: Windows PowerShell

```
PS C:\Users\nate_\Downloads\tiny11builder-main\tiny11builder-main> ls


    Directory: C:\Users\nate_\Downloads\tiny11builder-main\tiny11builder-main


Mode                 LastWriteTime         Length Name
----                 -------------         ------ ----
d-----         10/9/2024   3:34 PM                .github
-a----         10/9/2024   3:34 PM           2000 autounattend.xml
-a----         10/9/2024   3:34 PM           4422 README.md
-a----         10/9/2024   3:34 PM          48536 tiny11Coremaker.ps1
-a----         10/9/2024   3:34 PM          29093 tiny11maker.ps1


PS C:\Users\nate_\Downloads\tiny11builder-main\tiny11builder-main> .\tiny11maker.ps1

Security warning
Run only scripts that you trust. While scripts from the internet can be useful, this script can pot
computer. If you trust this script, use the Unblock-File cmdlet to allow the script to run without
message. Do you want to run C:\Users\nate_\Downloads\tiny11builder-main\tiny11builder-main\tiny11ma
[D] Do not run  [R] Run once  [S] Suspend  [?] Help (default is "D"): R
```

bloatware. For instance, Plex media server and Netflix are listed.

If you click 'Confirm' to remove any programs, the utility will also ask if you wish to remove the corresponding pinned app from the Start Menu.

Win11DeBloat also asks if you want to disable telemetry, diagnostic data, activity history, app-launch tracking, and targeted ads.

You can also take the same for suggestions and ads in the Start Menu, as well as the file explorer and lockscreen. The utility also supports removing Bing and Copilot.

Make your choices, then press enter to execute.

Manage startup programs

Generally speaking, uninstalling a program will prevent it from loading on your device again. However, more insidious forms of bloatware might propagate themselves across your machine, reinstalling themselves the next time you reboot.

The easiest way to list programs that launch on login is to enter 'startup' into the search bar to open 'Startup Apps'.

From here, you can work through the listed applications, then select the rocker switch next to each one as you see fit. Remember, this setting only governs whether a program launches or not. If you want to remove an application, repeat the steps outlined above.

Certain types of bloatware, like adware, may place an entry in the Windows Registry. This ensures that the application can restart, even if it's disabled in App Settings **[Image C]**.

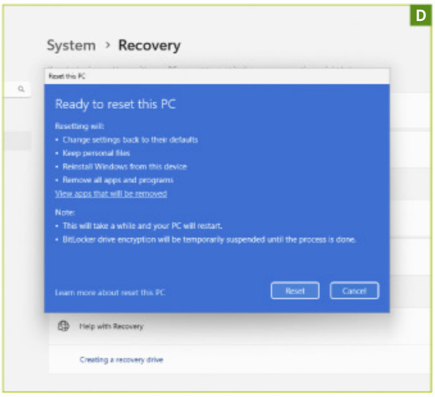
To fix this, save and close any open files, then launch 'System Configuration' via the Windows search bar. In the 'Boot' tab, check 'Safe boot', then choose 'Apply'.

You can now restart your device in safe mode. This means that if there are any third-party programs capable of downloading/reinstalling bloatware, they won't launch for this session.

Once you're in the safe mode desktop, enter 'regedit' into the search bar to launch the Registry Editor.

Bloatware may be installed for a particular user, or for anyone using your Windows device. To be on the safe side, check the following four Registry sections:

- HKEY_LOCAL_MACHINE\Software\Microsoft\Windows\CurrentVersion\Run
- HKEY_LOCAL_MACHINE\Software\Microsoft\Windows\CurrentVersion\RunOnce



D

Ready to reset this PC

Resetting will:

- Change settings back to their defaults
- Keep personal files
- Reinstall Windows from this device
- Remove all apps and programs

View apps that will be removed

Note:

- This will take a while and your PC will restart.
- BitLocker drive encryption will be temporarily suspended until the process is done.

- HKEY_CURRENT_USER\Software\Microsoft\Windows\CurrentVersion\Run
- HKEY_CURRENT_USER\Software\Microsoft\Windows\CurrentVersion\RunOnce

If you see any applications you don't recognize and/or don't need, right-click the corresponding 'Name', and delete it.

If you don't feel comfortable tinkering directly with the Registry, the above-mentioned CCleaner can help.

Relaunch the utility, then choose 'Tools' > 'Registry'. From here, you can scan for common issues.

Check the following boxes:

- Applications
- Application Paths
- Installer
- Obsolete Software
- Run at Startup

Choose 'Scan for Issues' > 'Review selected issues'. You can now remove related registry entries.

Resetting Windows

Once you've restarted your device from safe mode ideally no more bloatware will be present and you'll notice a significant increase in system performance.

If this isn't the case then you can, as Microsoft Support puts it, 'Give your PC a Fresh Start'. This effectively amounts to performing a clean install of Windows 11. You should only proceed once you've made a full backup of all your personal files.

When this is done, enter 'reset' into the Windows search bar to launch 'Reset This PC'. Under 'Recovery options', choose 'RESET PC' **[Image D]**. You can choose to 'Remove Everything', but the 'Keep my files' options should remove apps and settings without affecting personal files like your Documents folder.

Choose 'Cloud download' or 'Local reinstall' as you see fit. Click into 'View apps that will be removed', and check it carefully before selecting 'Reset'.

Once the reinstall is complete, you may still find programs that you don't want or need. This is because Microsoft bundles applications like Copilot and Xbox Gaming Service, which many people don't use.

The easiest way to fix this is to repeat the previous steps to download and run Win11DeBloat. However, this time when the utility launches, it's safe just to choose option 1 (Default mode). This will remove the most common types of Microsoft bloatware.

Browser bloatware

Web browsers can be just as susceptible to bloatware as your operating system. These don't usually come preinstalled, but sometimes, people download extensions they don't need.

One common culprit is ad blockers, as some web users imagine that having multiple add-ons like these equals better protection. In all likelihood, they will interfere with one another.

The specific steps to view your currently installed extensions vary by browser. For instance, Chrome and Edge users can select the options button at the top right, then 'Extensions' > 'Manage extensions'.

Extensions can be disabled temporarily, but if you've no need for them, it's best to just choose 'Remove'.

Some browsers, like Edge, will also distinguish between add-ons installed from official sources (in this case, the Edge Store) and those from other sources.

If you're concerned about surfing safely, we recommend installing a single ad blocker (uBlock Origin is an excellent choice), and a single extension for blocking trackers, like Ghostery.

If you're using Edge, you can also remove some of its less helpful suggestions by going to 'Settings' > 'Privacy, search and services'. Here, you can disable 'Personalisation and Advertising'. Scroll to the 'Security' section to disable features like Shopping suggestions.

We recommend doing the above even if you use a more privacy-focused browser, like Brave or Vivaldi. This is because many Microsoft apps will open web links by default in Edge.

If you still have CCleaner, launch it and go to 'Tools' > 'Browser Plugins'. You can 'Disable' or 'Delete' extensions configured to launch with your browser.

If you're not sure if this is safe, choose 'Disable' and use a website like file.net to research the extension. For instance, we discovered the Browser Helper Object ie_to_edge_bho.dll isn't essential. ■

Browser tips

Secret settings and best extensions

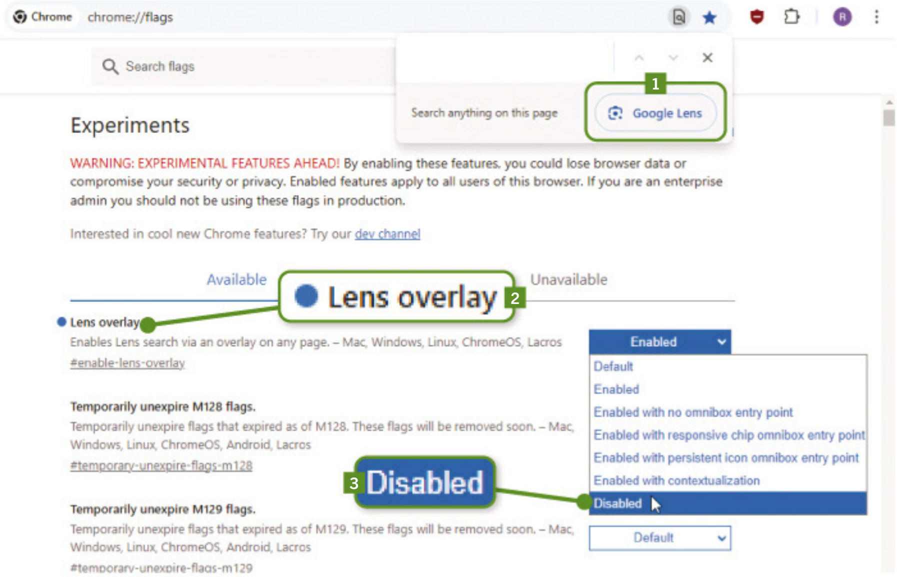
CHROME
Disable the 'Search with Google Lens' feature

Google has now integrated its AI-powered tool Google Lens with Chrome. This lets you search for information about content on a web page – including text, images and videos – without typing anything. Instead you use Google Lens to capture a screenshot of selected content, and it displays 'visual matches' from across the web in the browser's sidebar.

It's potentially useful but Google's implementation of the feature seems heavy-handed. A 'Search with Google Lens' option now appears in Chrome's address bar, its main (three-dot) menu, the right-click menu and even in the 'Find on page' box (1 in our screenshot below) that opens when you press the Ctrl+F keyboard shortcut.

You'll probably find all this annoying if you don't disable the feature or at least reduce its presence in the browser. Type chrome://flags in the address bar and press Enter to load the Experiments page. Find the entry Lens overlay 2, select Disabled in its dropdown menu 3 and click Relaunch. When Chrome reopens, all mention of Google Lens will have gone.

Alternatively, to keep Google Lens but remove its button from the address bar, choose 'Enabled with no omnibox entry point' in the dropdown menu. Google may eventually ditch the option to disable Lens, but it's likely the feature itself is here to stay.


Chrome
chrome://flags
Search flags
Search anything on this page
1
Google Lens
Available
Unavailable
Lens overlay
2
Enabled
Default
Enabled
Enabled with no omnibox entry point
Enabled with responsive chip omnibox entry point
Enabled with persistent icon omnibox entry point
Enabled with contextualization
Disabled
3
Disabled
Default

Experiments

WARNING: EXPERIMENTAL FEATURES AHEAD! By enabling these features, you could lose browser data or compromise your security or privacy. Enabled features apply to all users of this browser. If you are an enterprise admin you should not be using these flags in production.

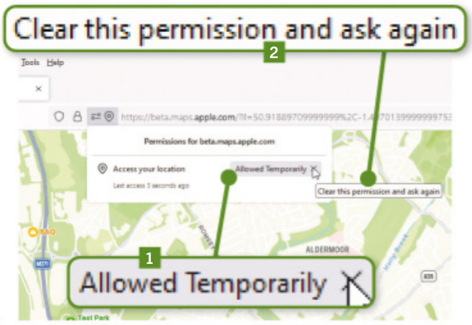
Interested in cool new Chrome features? Try our dev channel

Lens overlay
Enables Lens search via an overlay on any page. – Mac, Windows, Linux, ChromeOS, Lacros
#enable-lens-overlay

Temporarily unexpire M128 flags.
Temporarily unexpire flags that expired as of M128. These flags will be removed soon. – Mac, Windows, Linux, ChromeOS, Android, Lacros
#temporary-unexpire-flags-m128

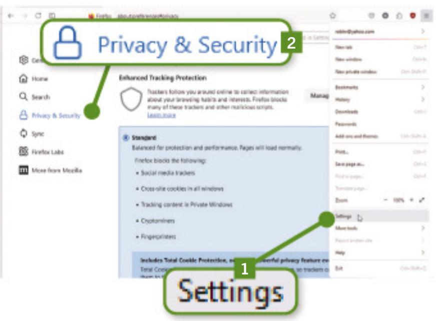
Temporarily unexpire M129 flags.
Temporarily unexpire flags that expired as of M129. These flags will be removed soon. – Mac, Windows, Linux, ChromeOS, Android, Lacros
#temporary-unexpire-flags-m129

FIREFOX
Grant websites temporary permissions

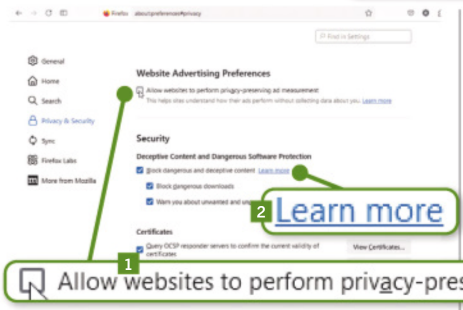

Clear this permission and ask again
2
Tools
Help
Permissions for beta.maps.apple.com
Access your location
Last access 3 seconds ago
Allowed Temporarily
Clear this permission and ask again
ALDERMOOR
1
Allowed Temporarily

Workshop

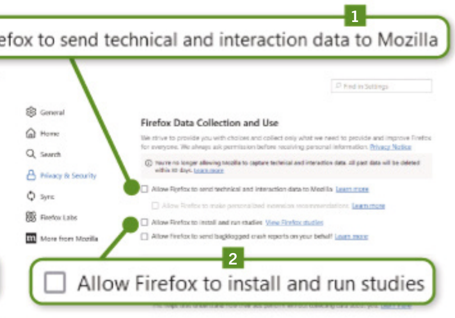
Disable features that track you in Firefox


Privacy & Security
2
1
Settings

To switch off the controversial new Privacy-Preserving Attribution feature in Firefox, either click the browser's three-line menu button and choose Settings 1, or go straight to about:preferences. Next, click the 'Privacy & Security' tab 2.


Website Advertising Preferences
Security
2
Learn more
1
☐ Allow websites to perform privacy-preserving ad measurement

Scroll down to the Website Advertising Preferences section and untick the 'Allow websites to perform privacy-preserving ad measurement' option 1. Click 'Learn more' 2 to find out why Mozilla added this ill-advised feature to Firefox.


1
☐ Allow Firefox to send technical and interaction data to Mozilla
Firefox Data Collection and Use
2
☐ Allow Firefox to install and run studies

On the same tab, you can disable other options that track you. In the 'Firefox Data Collection and Use' section, untick 'Allow Firefox to send technical and interaction data to Mozilla' 1 and 'Allow Firefox to install and run studies' 2.

Best extension for… Skipping ads on YouTube

YOUTUBE AD ACCELERATOR & EASY SPEED DRAG

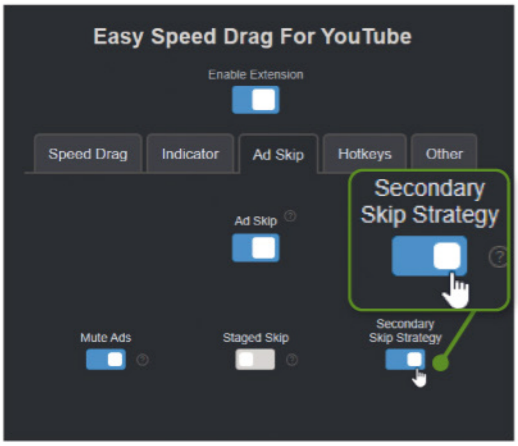
Chromium

tinyurl.com/APC541easy

YouTube's war on ad blockers has made it almost impossible to avoid seeing adverts before and during videos. This extension evades the site's detection and blocking of ad blockers by fast-forwarding commercials instead, playing them up to 16 times faster. All you'll see is the first few frames of the advert, before skipping directly to the video you want to watch. When an ad can't be skipped automatically, the add-on displays a huge Skip button you can click to skip it manually.

'YouTube Ad Accelerator & Easy Speed Drag' also lets you fast-forward and rewind the actual videos by clicking and dragging right or left with your cursor.

If you find some adverts are slipping through, try enabling the 'Secondary Skip Strategy' option in the extension's settings (see screenshot).



If you don't like that, try…

AUTOSKIP FOR YOUTUBE ADS

Chromium

tinyurl.com/APC541auto

This popular extension also skips YouTube ads, but recent user reviews suggest it's no longer entirely effective.

It's sometimes necessary to give a website permission to access features in your browser, so it can provide relevant information and work properly. For example, you may need to allow a mapping site access to your current location, or a video-chat service to use your webcam and microphone.

The trouble is once you grant that permission, the site might abuse that privilege in future and compromise your privacy. Firefox 131, released 1 October, addresses this concern by giving sites only temporary permissions to access the browser's features. These permissions are removed automatically after one hour, or when you close the site's tab.

This new option works automatically when you click Allow to grant a site permission such as Location, Camera or Microphone. You can confirm it's working by clicking the permission's icon to the left of the site URL.

Here you'll see that the permission is allowed temporarily (1 in our screenshot below) as well as when the website last accessed the relevant feature. To revoke the permission early, click the 'x' and refresh the page, so the site needs to ask again 2.

A less welcome addition to Firefox's privacy settings is Mozilla's new Privacy-Preserving Attribution (PPA) feature. This allows the browser to collect and share information about how you interact with adverts, supposedly as a more private alternative to cookies. However, because the option is enabled by default, digital-rights groups have accused Mozilla of tracking users without their consent (**www.snipca.com/52395**). See our Workshop opposite to learn how to disable PPA.

EDGE

Access Copilot from the address bar

Microsoft has introduced another way to interact with its AI assistant Copilot. As well as clicking the Copilot button in Windows 11, or the one built into Edge, you can now access the chatbot directly from the browser's address bar.

Type @copilot into your address bar, press Space and the browser will switch to 'Ask Copilot' mode (1 in our screenshot below). Enter a command or query and press Enter to open the Microsoft Copilot website (**https://copilot.microsoft.com**). Here you can view the AI tool's response and continue your conversation.

Although this is less convenient than clicking Edge's Copilot button 2 to start a chat in the sidebar, it's presumably aimed at users who have hidden that feature in the browser's settings. The Copilot website lets you access additional options, such as the new Copilot Voice feature. This lets you talk aloud to the AI assistant and hear it respond in one of four different voices – as if you were speaking to a real person.

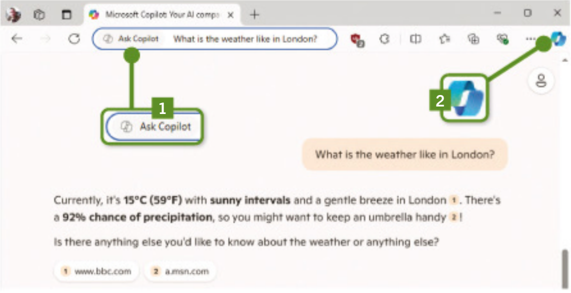
OPERA

Chat with Aria without signing in

In other AI browser news, Opera now lets you use its Aria assistant without needing to sign into – or up for – an Opera account. The requirement was removed in version 114, released at the end of September, and should encourage more users to try Aria in Opera's desktop browser and mobile app.

To access Aria, either click its button on Opera's left-hand sidebar (1 in our screenshot above) to open a chat window or press Ctrl+/ (forward slash) to use its command-line version. The first time you enter a query without signing in, you'll be asked to read and agree to Aria's terms of service. Click 'I Agree' 2 to continue your conversation.

You can use all Aria's features as if you were signed in, though you'll be limited to generating five images. Once you reach that limit, you'll be prompted to sign in – after doing so, Opera lets you create up to 30 free images per day. Signing into an Opera account also saves your Aria chat history, which will otherwise be wiped at the end of your session. See **www.snipca.com/52394** for more information. ■



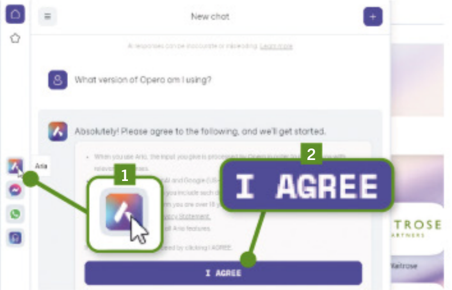
What is the weather like in London?

What is the weather like in London?

Currently, it's **15°C (59°F)** with **sunny intervals** and a gentle breeze in London 1. There's a **92% chance of precipitation**, so you might want to keep an umbrella handy 2!

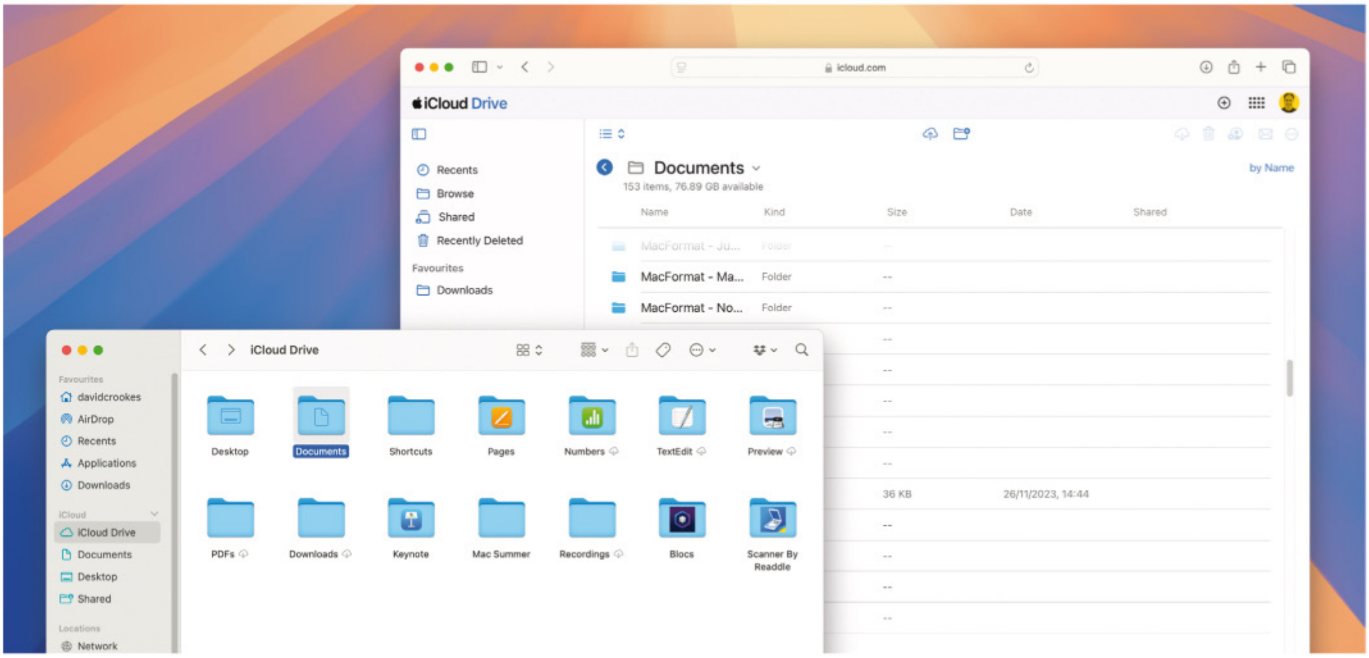
Is there anything else you'd like to know about the weather or anything else?

1 www.bbc.com 2 a.msn.com



What version of Opera am I using?

Absolutely! Please agree to the following, and we'll get started.

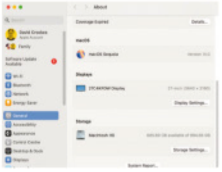

iCloud Drive
Recents
Browse
Shared
Recently Deleted
Favourites
Downloads
Documents
153 items, 76.89 GB available
by Name
Name
Kind
Size
Date
Shared
MacFormat - Ma...
MacFormat - No...
Folder
36 KB
26/11/2023, 14:44
davidcrookes
AirDrop
Applications
iCloud
Desktop
Locations
Network
Shortcuts
Pages
Numbers
TextEdit
Preview
PDFs
Keynote
Mac Summer
Recordings
Blocs
Scanner By Readdle

Manage your iCloud Drive

When your Mac is tight for space, iCloud Drive can do the heavy lifting

IT WILL TAKE
20 mins
YOU WILL LEARN
How to efficiently store files in the cloud and ensure they're available everywhere
YOU'LL NEED
Mac, preferably with macOS 15 or later, and iCloud set up

GENIUS TIP!
Enable Optimise Mac Storage and evicted files can lead to storage debt. With less Mac space than in iCloud Drive, you can't disable optimisation.



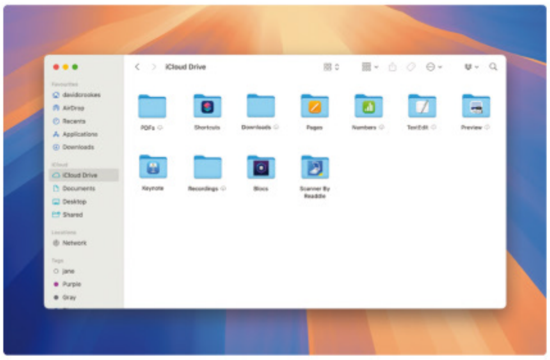
For years, we've become accustomed to using iCloud Drive. Aside from being a great way of backing up your files and making them available across all of your devices, it provides more storage space for you to play around with and, since it's baked into macOS, it pretty much works seamlessly. So much so that most of the time you're not even aware you're using it.

But that's not to say you won't benefit from better management of the service and it's worth learning a little more about what makes iCloud Drive tick. Here we're going to give you an insight into its structure, look at how easy (or hard) it is to back up those files and whether you're always going to enjoy offline access. We also explain some key decisions you'll have to make and we explore new features too.

In doing so, we're concentrating on the Mac in this guide, but don't forget that iCloud Drive is accessible on an iPhone or iPad and via a browser online at **iCloud.com**.

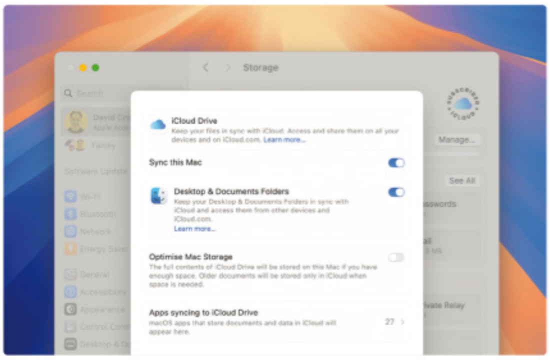
David Crookes ■

How to Work with iCloud Drive


iCloud Drive
Favourites
davidcrookes
AirDrop
Recents
Applications
Downloads
iCloud
iCloud Drive
Documents
Desktop
Shared
Locations
Network
Tags
Purple
Gray
PDFs
Shortcuts
Downloads
Pages
Numbers
TextEdit
Preview
Keynote
Recordings
Blocs
Scanner By Readdle

5 Open the Finder app

When you set up and sign into iCloud, you will be able to access iCloud Drive by launching the Finder app. Click iCloud Drive in the sidebar and you'll see dedicated folders for apps such as Pages, Numbers and Keynote.


Storage
Manage...
See All

iCloud Drive
Keep your files in sync with iCloud. Access and share them on all your devices and on iCloud.com. Learn more...

Sync this Mac

Desktop & Documents Folders
Keep your Desktop & Documents Folders in sync with iCloud and access them from other devices and iCloud.com.
Learn more...

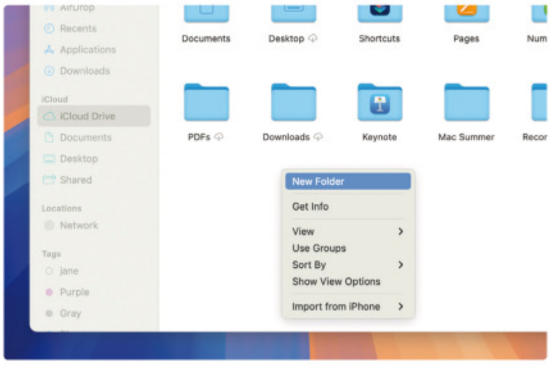
Optimise Mac Storage
The full contents of iCloud Drive will be stored on this Mac if you have enough space. Older documents will be stored only in iCloud when space is needed.

Apps syncing to iCloud Drive
macOS apps that store documents and data in iCloud will appear here. 27

6 Sync your folders

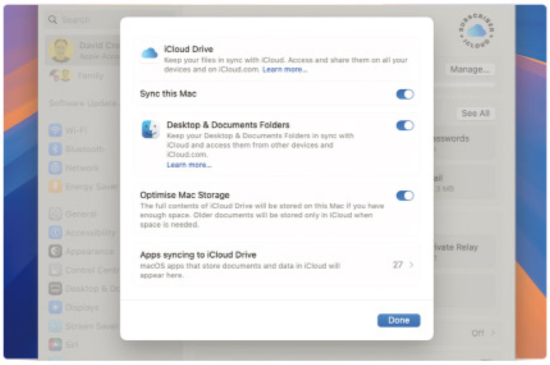
You can sync Desktop and Documents folders. From the Apple menu, choose System Settings > Apple Account > iCloud. Select Drive under 'Saved to iCloud' and toggle 'Desktop & Documents Folders' on.

Continued… Work with iCloud Drive


AirDrop
Recents
Applications
Downloads
iCloud
iCloud Drive
Documents
Desktop
Shared
Locations
Network
Tags
Jane
Purple
Gray
Documents
Desktop
Shortcuts
Pages
Num
PDFs
Downloads
Keynote
Mac Summer
Recor
New Folder
Get Info
View
Use Groups
Sort By
Show View Options
Import from iPhone

1 Create new folders

Syncing those folders lets you access any files stored within them across any device and they are still stored locally. You can also create your own folders in iCloud Drive in the same way as you would on your Mac.


iCloud Drive
Keep your files in sync with iCloud. Access and share them on all your devices and on iCloud.com. Learn more…

Sync this Mac

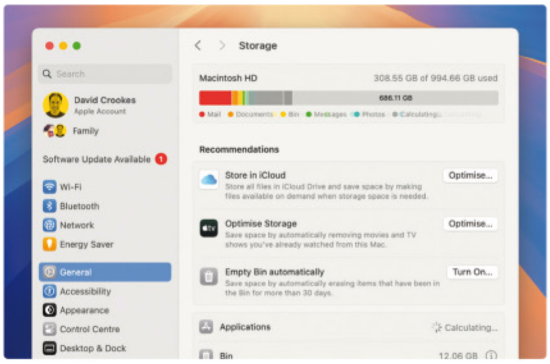
Desktop & Documents Folders
Keep your Desktop & Documents Folders in sync with iCloud and access them from other devices and iCloud.com.
Learn more…

Optimise Mac Storage
The full contents of iCloud Drive will be stored on this Mac if you have enough space. Older documents will be stored only in iCloud when space is needed.

Apps syncing to iCloud Drive 27
macOS apps that store documents and data in iCloud will appear here.

2 Optimise Mac Storage

The menu you saw by following step 2 also gives an option to toggle Optimise Mac Storage. This will affect locally stored files – if space is needed on a Mac, some local files will be evicted and stored only in iCloud.


Storage

Macintosh HD 308.55 GB of 994.66 GB used
686.11 GB

Recommendations

Store in iCloud
Store all files in iCloud Drive and save space by making files available on demand when storage space is needed.

Optimise Storage
Save space by automatically removing movies and TV shows you've already watched from this Mac.

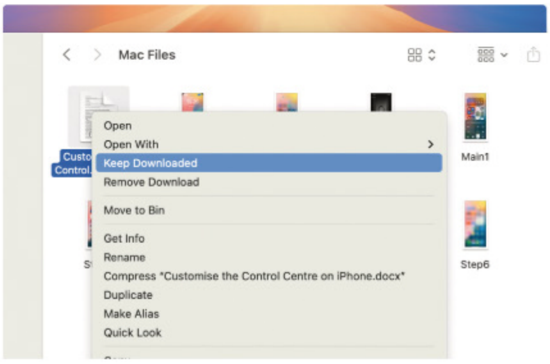
Empty Bin automatically
Save space by automatically erasing items that have been in the Bin for more than 30 days.

Applications Calculating…
Bin 12.06 GB

Search
David Crookes
Apple Account
Family
Software Update Available
Wi-Fi
Bluetooth
Network
Energy Saver
General
Accessibility
Appearance
Control Centre
Desktop & Dock
Mail
Documents
Bin
Messages
Photos
Calculating…
Optimise…
Optimise…
Turn On…

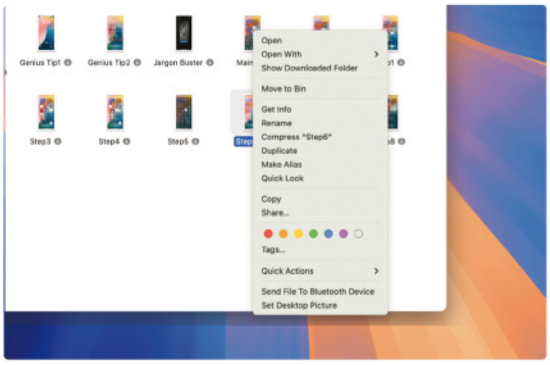
3 Free up space

The Optimise Mac Storage option also appears as a recommendation if you select System Settings > General > Storage. It's beneficial when space is limited on your Mac. Files can still be accessed and downloaded.


Mac Files
Open
Open With
Keep Downloaded
Remove Download
Move to Bin
Get Info
Rename
Compress "Customise the Control Centre on iPhone.docx"
Duplicate
Make Alias
Quick Look
Main1
Step6

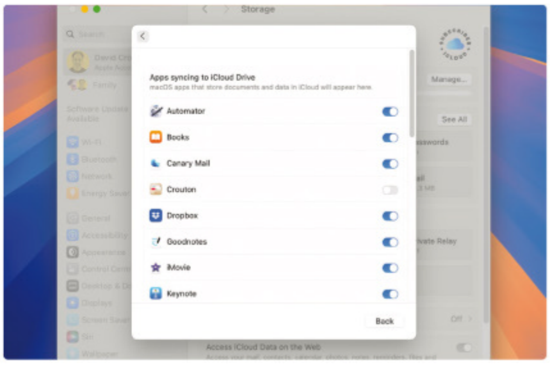
4 Pin Drive files

But what if you want certain files and folders to remain local? In macOS Sequoia, just Ctrl-click and pin them by selecting Keep Downloaded – these files or folders will stay on your Mac and remain accessible offline.


Genius Tip1
Genius Tip2
Jargon Buster
Step3
Step4
Step5
Open
Open With
Show Downloaded Folder
Move to Bin
Get Info
Rename
Compress "Step6"
Duplicate
Make Alias
Quick Look
Copy
Share…
Tags…
Quick Actions
Send File To Bluetooth Device
Set Desktop Picture

5 Stop pinning files

There are some oddities. You can only pin up to 10 files or folders at a time and, while you can Ctrl-click and untick Keep Downloaded files to unpin, if you pin a folder, you can't open it and unpin individual files.


Apps syncing to iCloud Drive
macOS apps that store documents and data in iCloud will appear here

Storage
Automator
Books
Canary Mail
Crouton
Dropbox
Goodnotes
iMovie
Keynote
Back
Access iCloud Data on the Web

6 Manage the space

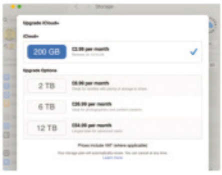
Of course, the more you store in iCloud Drive, the more space you'll take up. Control this by checking the apps which sync to it. Just follow step 2, but this time click Apps Syncing and turn off those you don't need.

JARGON BUSTER

When a file is **evicted**, it is locally visible on a Mac but its data is sent to iCloud Drive. Evicted files can't be backed up using Time Machine.

GENIUS TIP!

Need more iCloud Drive space? You can purchase extra via System Settings > Apple Account > iCloud > Manage. Monthly plans go up to 12TB.


200 GB
2 TB
6 TB
12 TB

Easy de-archiving

Shashank Sharma considers himself to be a multitasking maestro, and is naturally impressed with nifty utilities that can do the job of many.

The Linux distro is home to a large number of compression utilities, each with its own myriad subcommands and options. Remembering them all is a Herculean challenge, even for veterans. What complicates the situation further is that no single tool is equipped to handle all of the many different file formats, such as TAR, BZ2, GZIP, GZ, TAR.GZ, RAR and so on.

Released under the GPLv3 licence, Patool is a portable archive file manager written in Python. You no longer have to rely on separate commands or remember their myriad options, as Patool supports just about all archive and compression formats. Even better, it uses sane and generic command options such as `extract` and `create` to respectively decompress an archive or to make one from the supplied set of files.

The project's website suggests running the `sudo pip install patool` command to install Patool. While this might work for some distros, Debian and recent iterations of Ubuntu no longer allow installing Python packages in this way. If your distro throws up an `externally managed environment` error when you run the `pip install` command, but you still want to install packages using Pip, your only option is to create a virtual environment. Thankfully, there's a quicker workaround that works for all distros.

You must have Python 3.10 or greater on your machine, as all other dependencies are likely already installed if you've been using your distro for any length of time. Head over to the project's GitHub page (**https://github.com/wummel/patool**) and download the latest tarball. You can now use the bundled setup.py script to install Patool:

```
$ tar xvf patool-3.0.1.tar.gz
$ cd patool-3.0.1/
$ sudo python setup.py install
```

The last line utilises the setup.py script to install Patool in the /usr/local/bin/ directory.

Archives demystified

The objective of Patool is to simplify the process of working with archive files. You can use the nifty utility to create archives, extract files, list archive contents, compare archives, search for files within archives, and even repack archives to a different format.

First, let's create an archive with `patool create test-archive.zip <filename1> <filename2>` :

```
$ patool create test-archive.zip BCD_Verification.pdf Letter-delay.pdf
INFO patool: Creating test-archive.zip ...
INFO patool: ... test-archive.zip created.
$ patool list test-archive.zip
INFO patool: Listing test-archive.zip ...
BCD_Verification.pdf
Letter-delay.pdf
```

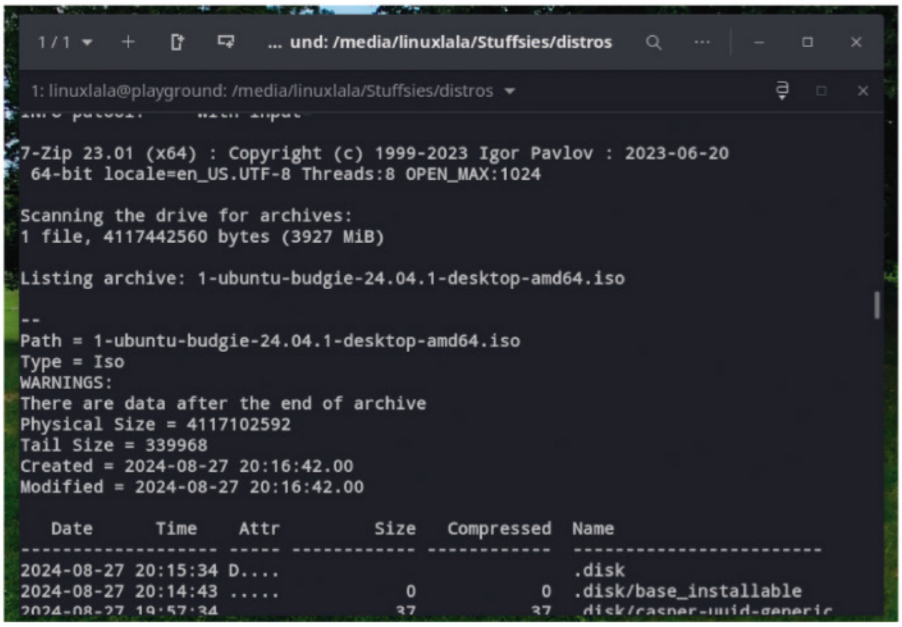
Patool automatically identifies the type of archive you wish to create, and runs the relevant command to perform the operation. For instance, when creating a TAR.GZ archive, Patool runs the `usr/bin/tar --create --gzip --force-local --file another-archive.tar.gz -- <filename1> <filename2>` command. It similarly runs the `usr/bin/tar --create --bzip2 --force-local --file third-archive.tar.bz2 -- <filename> <filename-2>` command if you opt to create a TAR.BZ2 archive instead.

The `patool list <archive-name>` command can list the contents of an archive, without extracting files.

Another significant advantage of Patool is that a single command can be used to extract files from different archives. For instance, if you have a TAR.GZ and a RAR archive, instead of running separate commands to extract the files, you can run the `patool extract <archive1> <archive2>` command, where the two or more archives are different file formats, and Patool extracts the files.

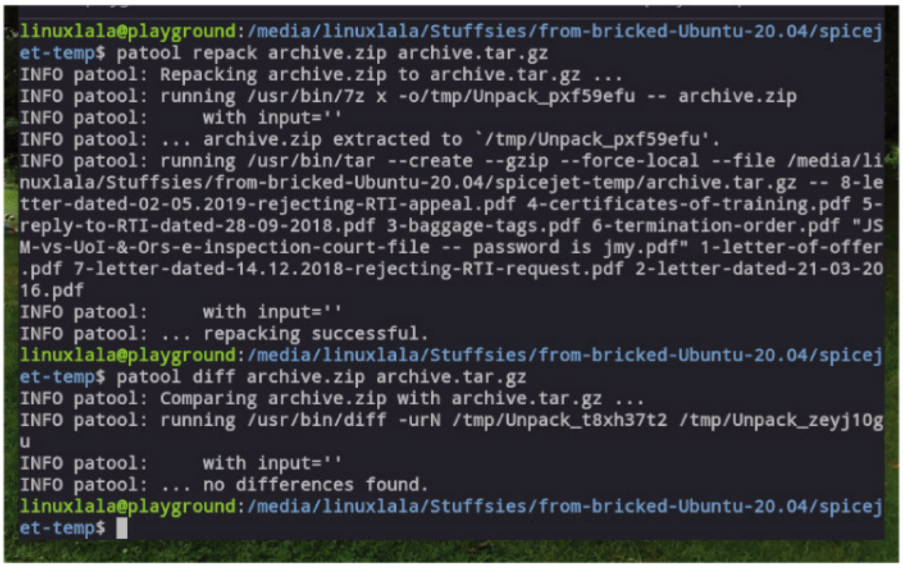
The command `patool extract archive.zip another-archive.tar.gz third-archive.tar.bz2` extracts the files from each archive into the archive, another-archive and third-archive directories respectively.

When extracting files from an archive, Patool is sensitive enough to not populate the contents of the archive in the current working directory. Instead, it extracts files from an archive to its own directory. This is especially useful if you use Patool to simultaneously extract files from multiple archives.


1 / 1
... und: /media/linuxlala/Stuffsies/distros
1: linuxlala@playground: /media/linuxlala/Stuffsies/distros

```
7-Zip 23.01 (x64) : Copyright (c) 1999-2023 Igor Pavlov : 2023-06-20
 64-bit locale=en_US.UTF-8 Threads:8 OPEN_MAX:1024

Scanning the drive for archives:
1 file, 4117442560 bytes (3927 MiB)

Listing archive: 1-ubuntu-budgie-24.04.1-desktop-amd64.iso

--
Path = 1-ubuntu-budgie-24.04.1-desktop-amd64.iso
Type = Iso
WARNINGS:
There are data after the end of archive
Physical Size = 4117102592
Tail Size = 339968
Created = 2024-08-27 20:16:42.00
Modified = 2024-08-27 20:16:42.00

   Date      Time    Attr         Size   Compressed  Name
------------------- ----- ------------ ------------  ------------------------
2024-08-27 20:15:34 D....                            .disk
2024-08-27 20:14:43 .....            0            0  .disk/base_installable
2024-08-27 19:57:34                 37           37  .disk/casper-uuid-generic
```

No matter the archive format, Patool always extracts the contents into a dedicated directory.



```
linuxlala@playground:/media/linuxlala/Stuffsies/from-bricked-Ubuntu-20.04/spicej
et-temp$ patool repack archive.zip archive.tar.gz
INFO patool: Repacking archive.zip to archive.tar.gz ...
INFO patool: running /usr/bin/7z x -o/tmp/Unpack_pxf59efu -- archive.zip
INFO patool:     with input=''
INFO patool: ... archive.zip extracted to `/tmp/Unpack_pxf59efu'.
INFO patool: running /usr/bin/tar --create --gzip --force-local --file /media/li
nuxlala/Stuffsies/from-bricked-Ubuntu-20.04/spicejet-temp/archive.tar.gz -- 8-le
tter-dated-02-05.2019-rejecting-RTI-appeal.pdf 4-certificates-of-training.pdf 5-
reply-to-RTI-dated-28-09-2018.pdf 3-baggage-tags.pdf 6-termination-order.pdf "JS
M-vs-UoI-&-Ors-e-inspection-court-file -- password is jmy.pdf" 1-letter-of-offer
.pdf 7-letter-dated-14.12.2018-rejecting-RTI-request.pdf 2-letter-dated-21-03-20
16.pdf
INFO patool:     with input=''
INFO patool: ... repacking successful.
linuxlala@playground:/media/linuxlala/Stuffsies/from-bricked-Ubuntu-20.04/spicej
et-temp$ patool diff archive.zip archive.tar.gz
INFO patool: Comparing archive.zip with archive.tar.gz ...
INFO patool: running /usr/bin/diff -urN /tmp/Unpack_t8xh37t2 /tmp/Unpack_zeyj10g
u
INFO patool:     with input=''
INFO patool: ... no differences found.
linuxlala@playground:/media/linuxlala/Stuffsies/from-bricked-Ubuntu-20.04/spicej
et-temp$ 
```

Make sure to delete the source archives if you use the ‘patool repack’ command to create a different archive format.

In addition to standard archive files, you can also use the `patool list` command to view the contents of DEB package and even ISO and CHMfiles, if you have the right packages installed.

You can run the `patool formats` command for a list of all the file formats supported by the utility. While most commonly used formats are supported out of the box, the command informs you of the packages you need to install if you want to work with other archive formats. For instance, we had to install the 7zip package before we could work with 7Z archives.

It’s also possible to use Patool to repack archives in one format to another with the `patool repack <source-archive> <destination-archive>` command:

```
$ patool repack test-archive.zip test-archive.tar.gz
INFO patool: Repacking test-archive.zip to test-archive.tar.gz ...
INFO patool: ... test-archive.zip extracted to `/tmp/Unpack_wpq74mci’.
INFO patool: running /usr/bin/tar --create --gzip --force-local --file /home/linuxlala/Downloads/test-archive.tar.gz -- “Letter-delay.pdf” BCD_Verification.pdf
INFO patool:          with input=’’
INFO patool: ... repacking successful.
```

The `repack` command automatically identifies the source and target archive formats, and executes the relevant commands to create the new archive. The command doesn’t replace the source archive, however, so with the above command, we end up with a test-archive.zip as well as test-archive.tar.gz files.

Search and diff

Patool also supports searching for files within archives. The archive is first extracted into a temporary directory and then the grep utility is used to find matching files. Unfortunately, we found the feature to be unreliable during our tests.

The command `patool search “string” <archive-name>` is straightforward enough, however the results are inconsistent. While the project could easily identify files in ZIP archives, Patool struggled to return results when working with any other archive format:

```
$ patool search “index” third-archive.tar.bz2
INFO patool: Searching ‘index’ in third-archive.tar.bz2 ...
INFO patool: running /usr/bin/grep -r -e index .
INFO patool:          with cwd=’/tmp/Unpack_e2rogteo’, input=’’
INFO patool: ... ‘index’ not found
$ patool list third-archive.tar.bz2
INFO patool: Listing third-archive.tar.bz2 ...
INFO patool: running /usr/bin/tar --list --bzip2 --force-local --file third-archive.tar.bz2
INFO patool:          with input=’’
indexed-vakalatnama.pdf
index-vakaltanma.doc
```

As you can see, we in fact have two files in the archive that match the provided search string, but Patool failed to find them. Providing an exact filename didn’t help either.

The `patool diff <archive1> <archive2>` command can be used to list differences in the content of specified archives. The archives can be in different formats, and you can even view the differences between more than two archives. The contents of the archives are extracted into a temporary directory but Patool doesn’t inform you which temporary directory is home to which archive. The output is thus difficult to make sense of.

Despite its poor handling of the search and diff features, Patool’s ease of use makes it an easy recommendation. However, the project could do with a little more polish and improved documentation. ■

THE PERL, PYTHON AND RUST PALS

While we often run into projects that provide similar functionality, most of them are usually programmed in the same language. This is what makes Atool, Patool and Ouch (**https://github.com/ouch-org/ouch**) unique.

Written in Perl, Atool (**www.nongnu.org/atool**) is the oldest of the three, first released in 2001. It supports many popular archive formats, but wasn’t featured as the subject of this tutorial because it hasn’t seen a new release since 2012.

Still, Atool boasts of all of Patool’s features, such as extracting files from an archive into a dedicated directory, repacking archives into a different format, and so on. One key difference between the two tools, however, is that while Patool uses subcommands for various operations, Atool comprises several different tools for each task it can perform. These include aunpack to extract files from an archive, apack to create archives and als to list the contents of an archive. You’ll find Atool in the software repositories of most desktop distros, so installing it is only a matter of running the `sudo apt install atool` command on DEB-based distros or `sudo dnf install atool` command on RPM distros.

Ouch (Obvious Unified Compression Helper) is a Rust utility that offers the same functionality as the Perl and Python counterparts. You use the `ouch decompress` command to extract the contents of an archive. The `ouch compress` command can similarly be used to create an archive. Run the `cargo install ouch` command to install it.

Phone & tablet tips

Brilliant things to do on your device.

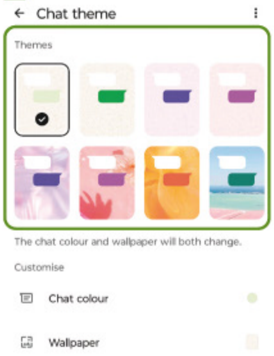
ANDROID & iOS

Apply different themes to WhatsApp chats

WhatsApp has added the option to customise your chats with colourful themes. Previously, you could change the default theme for all WhatsApp conversations, but the new feature lets you apply different themes to chats with specific people and groups.

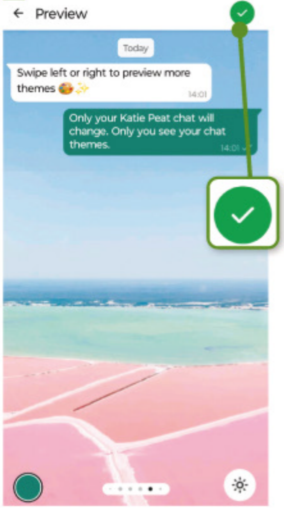
To pick a theme, tap the three-dot menu icon in the top-right corner of a chat and select 'Chat theme'. Choose a theme from the eight available options (see screenshot 1 below) to change the message-bubble colour and wallpaper for the current conversation.

1



The chat colour and wallpaper will both change.

2



Swipe left or right to preview more themes 🎨✨ 14:01

Only your Katie Peat chat will change. Only you see your chat themes. 14:01

Swipe left or right to see previews of each theme, and use the brightness control in the bottom-right to lighten or darken the design. Press the green tick button (see screenshot 2) to apply your chosen theme, then tap 'Set theme' to confirm.

You can customise the colour of message bubbles by tapping 'Chat colour' and choosing from 20 different shades. Tap 'Wallpaper' to select a different background design, from dozens of textured, solid-colour and photo wallpapers. You can even use one of your own pictures by tapping the 'Choose from gallery' option.

If you'd prefer to change the theme for all your WhatsApp conversations, tap the three-dot menu on the Chats tab and choose Settings then Chats. Select 'Default chat theme' to access the same options described above.

Note that your custom theme is only visible to you – the people you talk to in WhatsApp will still see its default green-and-white theme.

ANDROID & iOS

Try the new features in Vivaldi 7

Following the redesign of the Vivaldi desktop browser, the company has also updated its mobile app. Vivaldi 7 for Android (**tinyurl.com/APC541viv**) and iOS (**tinyurl.com/APC541vivio**) brings several useful features to both versions, but not exactly the same ones.

For example, in the Android browser, you can now quickly reopen accidentally closed tabs. To set this up, press the Vivaldi menu button, select Settings then Tabs, and switch on the 'Show Undo Message on Tab Close' option.

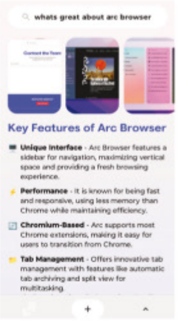
The iOS browser gets a new setting for changing the order of options in the Vivaldi menu. Tap the menu button, swipe down and select 'Customise menu'. Drag and drop the menu options so the most important are at the top, then press Done to save your new arrangement. Vivaldi has also added a Home button to the main toolbar, which was already present in the Android app.

Both versions have a new 'Top Sites' feature, which displays shortcuts to your favourite sites on your start page. To enable it, go to Settings then Start Page, and switch on Show Top Sites (on Android) or Display Top Sites (on iOS – see screenshot left).

Additionally, Vivaldi now instantly syncs your browsing data across devices, so you can pick up where you left off.

Best new apps

What you should install this month



Key Features of Arc Browser

- **Unique Interface** - Arc Browser features a sidebar for navigation, maximizing vertical space and providing a fresh browsing experience.
- **Performance** - It is known for being fast and responsive, using less memory than Chrome while maintaining efficiency.
- **Chromium-Based** - Arc supports most Chrome extensions, making it easy for users to transition from Chrome.
- **Tab Management** - Offers innovative tab management with features like automatic tab archiving and split view for multitasking.

ARC SEARCH

Free

Android tinyurl.com/APC541arc

iOS tinyurl.com/APC541arcio

Arc browser is now available on Android, letting you browse and search the web privately, with no pop-ups, trackers or ads. Use its 'Browse for Me' feature to get detailed answers to your search queries from six reliable sources. The iOS version has now been updated to support the new dark icons in iOS 18.

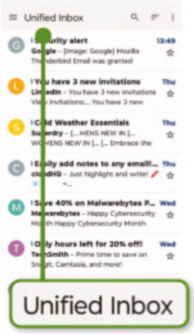
Cancel
Manual
Save

OPEN SCANNER

Free

iOS tinyurl.com/APC541scan

This new app offers a quick and easy way to scan documents, receipts, notes and other paper items using your iPhone or iPad's camera. It automatically recognises text, lets you annotate and edit scans, and can sync files to other devices via iCloud. Unlike similar scanning apps, it has no ads or in-app purchases.



Security alert 13:49
Google – [image: Google] Mozilla Thunderbird Email was granted

You have 3 new invitations Thu
LinkedIn – You have 3 new invitations View invitations:... You have 3 new

Cold Weather Essentials Thu
Superdry – [... MENS NEW IN [... WOMENS NEW IN [... [... Embrace the

Easily add notes to any email!... Thu
cloudHQ – Just highlight and write! ✏️

Save 40% on Malwarebytes P... Wed
Malwarebytes – Happy Cybersecurity Month Happy Cybersecurity Month

Only hours left for 20% off! Wed
TechSmith – Prime time to save on Snagit, Camtasia, and more!

THUNDERBIRD

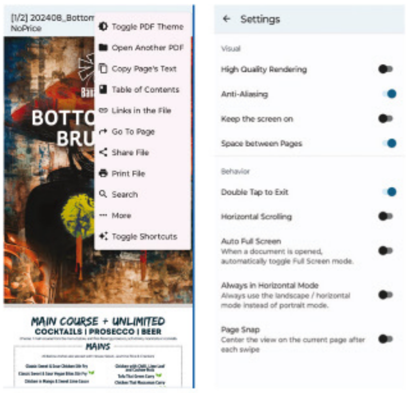
Free

Android tinyurl.com/APC541virgil

Thunderbird's long-awaited mobile app is finally here, though still in beta at the time of writing. This lets you manage all your email accounts in one place, either by switching between them as required or by combining messages in its Unified Inbox. It can also keep your emails private using end-to-end encryption.

*Contains in-app purchases

Best apps for... Working with PDF files


[1/2] 202408_Bottom
NoPrice
Toggle PDF Theme
Open Another PDF
Copy Page's Text
Table of Contents
Links in the File
Go To Page
Share File
Print File
Search
More
Toggle Shortcuts
Settings
Visual
High Quality Rendering
Anti-Aliasing
Keep the screen on
Space between Pages
Behavior
Double Tap to Exit
Horizontal Scrolling
Auto Full Screen
When a document is opened, automatically toggle Full Screen mode.
Always in Horizontal Mode
Always use the landscape / horizontal mode instead of portrait mode.
Page Snap
Center the view on the current page after each swipe
MAIN COURSE + UNLIMITED
COCKTAILS | PROSECCO | BEER
MAINS

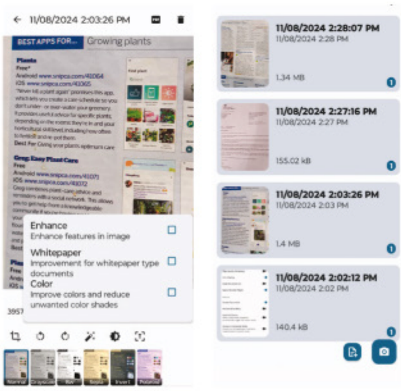
MJ PDF

Free

Android tinyurl.com/APC541mj

Most PDF viewers feature ads and in-app purchases, but the excellent MJ PDF is free of both of those and other annoyances. It quickly opens PDFs stored on or downloaded to your Android device, displays their content in high quality and lets you swiftly swipe through lengthy documents. You can also copy text from pages.

Best for: Quickly viewing PDFs


11/08/2024 2:03:26 PM
BEST APPS FOR...
Growing plants
Enhance
Enhance features in image
Whitepaper
Improvement for whitepaper type documents
Color
Improve colors and reduce unwanted color shades
11/08/2024 2:28:07 PM
11/08/2024 2:28 PM
1.34 MB
11/08/2024 2:27:16 PM
11/08/2024 2:27 PM
155.02 kB
11/08/2024 2:03:26 PM
11/08/2024 2:03 PM
1.4 MB
11/08/2024 2:02:12 PM
11/08/2024 2:02 PM
140.4 kB

OSS DOCUMENT SCANNER

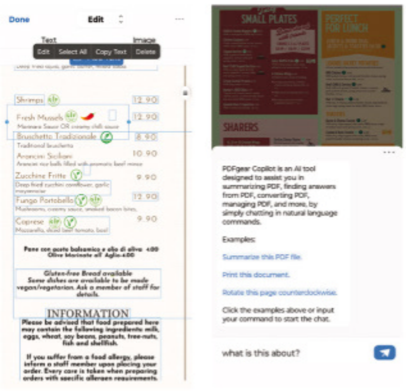
Free

Android tinyurl.com/APC541oss

iOS tinyurl.com/APC541ossio

This open-source app lets you scan documents using your phone's camera then save either selected text or the whole scan as a PDF. You can also convert files already stored on your device to PDFs. It offers options to brighten, enhance the quality and change the colours of scans, and has no ads or in-app purchases.

Best for: Scanning to PDF


Done
Edit
Text
Image
Edit
Select All
Copy Text
Delete
Shrimps
12.90
Fresh Mussels
12.90
Bruschetta Tradizionale
8.90
Arancini Siciliani
10.90
Zucchine Fritte
9.90
Fungo Portobello
12.90
Caprese
9.90
INFORMATION
SMALL PLATES
PERFECT FOR LUNCH
SHARERS

PDFgear Copilot is an AI tool designed to assist you in summarizing PDF, finding answers from PDF, converting PDF, managing PDF, and more, by simply chatting in natural language commands.

Examples:

Summarize this PDF file.

Print this document.

Rotate this page counterclockwise.

Click the examples above or input your command to start the chat.

what is this about?

PDFGEAR

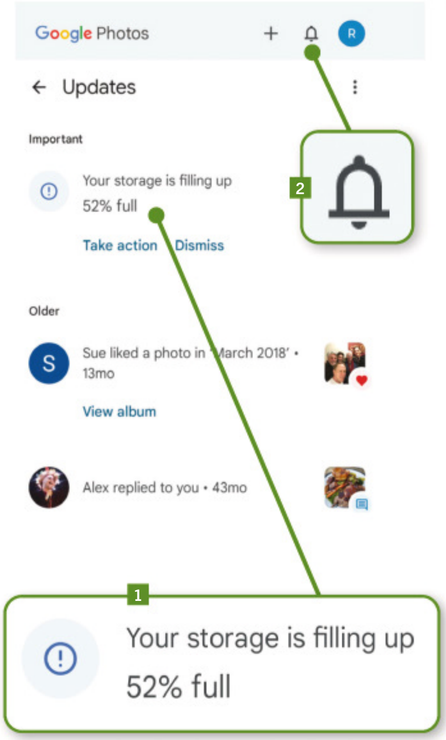
Free

Android tinyurl.com/APC541pdf

iOS tinyurl.com/APC541pdfio

PDFgear's mobile app isn't as packed with features as its desktop program, but it's still the most versatile free (and ad-free) PDF editor. It lets you add, delete and edit text, annotate and highlight content, insert images into documents, and reorganise pages. You can also use its AI tool to summarise and print PDFs.

Best for: Editing PDF files


Google Photos
R
Updates
Important
Your storage is filling up
52% full
Take action
Dismiss
Older
S
Sue liked a photo in 'March 2018' • 13mo
View album
Alex replied to you • 43mo
2
1
Your storage is filling up
52% full

ANDROID & iOS

View activity updates in Google Photos

The latest update to the Google Photos app for Android (**tinyurl.com/APC541gphot**) and iOS (**https://tinyurl.com/APC541gphotio**) fittingly relates to updates. It adds a new Updates page to the app that informs you of recent activity in your Photos albums and account.

This includes when someone adds a new photo to a shared album, shares an album with you, and comments on or 'likes' one of your pictures. It also tells you when a new shared 'memory' is available to view on the app's Memories tab, and warns you when your Google Photos storage is filling up (1 in our screenshot above).

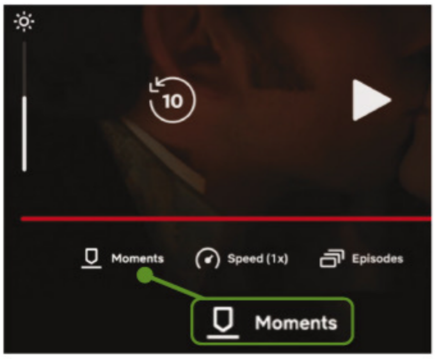
The Updates feature replaces the Sharing page in Google Photos. Tap the new bell icon in the top-right corner of the app 2 to view your recent updates. When new activity occurs, you'll see a number on this bell.

ANDROID & iOS

Save and share scenes from Netflix shows

Netflix has introduced a new feature called Moments, which lets you bookmark notable scenes in TV shows and films you're watching on your phone or tablet. You can then jump straight to those moments to rewatch them, without needing to skip there manually.

Moments also lets you share your


10
Moments
Speed (1x)
Episodes
Moments

saved scenes on social-media apps including WhatsApp, Facebook and Instagram, and copy links to them to your clipboard. However, other people will only be able to watch your moments if they are Netflix subscribers with the app installed.

To use the new feature while watching a Netflix show or film, tap the Moments button in the bottom-left corner of your screen (see screenshot right) and press Save. This will add a bookmark to your My Netflix tab, which you can tap to revisit that scene, and to share it with others.

Moments is available now in the Netflix app for iOS (**tinyurl.com/APC541momio**), and should be in the Android version (**tinyurl.com/APC541mom**) when you read this. ■

*Contains in-app purchases

Get live updates with the YouTube API

Seeking fame and fortune, Les Pounder wonders why he has only 586 subscribers on YouTube.

YOU'LL NEED

- Pi Pico W
- Breadboard
- I2C LCD display
- 4x F2M jumper wires
- Code: https://bit.ly/lxf322code

Are you a budding YouTuber and want to keep an eye on your subscriber numbers? We've got just the thing. We're making a Pi Pico W-powered subscriber counter using a low-cost LCD screen. It updates every hour with the latest subscriber numbers. We're also learning about the YouTube API.

First log in to the Google Cloud Console (**https://console.cloud.google.com/welcome**), then click on the project selector drop-down. In the new window, click on New Project. In the next window, give the project a name. Now click Create. Next we need to enable API access for the project.

In the left-hand menu, click on APIs & Services > Library. In the search bar, search for YouTube Data API v3. When the result pops up, click on it, then on Enable. The last step is to obtain the credentials (API key), which enable our project to use the YouTube API.

Head back to the APIs & Services section and select Credentials. Click on Create Credentials. Choose API Key and in a few seconds an API key is generated. Do not share this key or put it in any version control (like GitHub). Do make a copy of the key in a text editor.

The final task is to get our channel ID. Open a browser window and go to YouTube; make sure you are logged in. Click on your face icon, top-right, and select Settings. In the next screen, click Advanced Settings. Copy the channel ID and keep it safe in the text file.

Subscribers
586

The build is basic, but you could package this up into a 3D-printed case.

"We're making a Pi Pico W-powered subscriber counter using a low-cost LCD screen. It updates every hour with the latest subscriber numbers. We're also learning about the YouTube API."

Building the circuit

The LCD screen used in this project is fairly basic and resembles those used in vending machines. The I2C version of the HD4470 LCD display needs only four connections, much easier than the multiple pins in the non-I2C version. The circuit diagram in the download for this tutorial shows where to make the connections, and the table below provides a quick reference.

LCD Pin	Wire colour	Function	Pico pin
GND	Black	Ground reference	Any GND
VDD / VCC	Red	5V power	VBUS
SDA	Orange	I2C data	GP0
SCL	Yellow	I2C clock	GP1

We assume you have already installed Thonny for the Pico. If not, Tom's Hardware has a guide: **www.tomshardware.com/how-to/raspberry-pi-pico-setup**.

Open Thonny and connect the Pico to your machine. Go to Tools > Options > Interpreter. Set the interpreter to MicroPython (Raspberry Pi Pico) and set the Port to match the location of your Pico. Click OK. Thonny connects to the board and we now write code.

First, we need to install libraries (modules) to enable the Pico to talk to the I2C LCD screen.

We're using dhylands python_lcd (**https://github.com/dhylands/python_lcd/**). Create a new blank file in Thonny, then open a browser to **https://bit.ly/lxf322api** and copy the contents to Thonny. Save the file to the Raspberry Pi Pico as lcd_api.py.

Create another blank file and open another browser to **https://bit.ly/lxf322lcd**. Copy the contents to Thonny. Save the file as pico_i2c_lcd.py to the Pico.

Create another blank file to contain any passwords or API keys we need. In the file, create four objects for your Wi-Fi SSID, password, API key and channel ID. Replace the text inside the quotation marks with your Wi-Fi details – do not delete the quotation marks as this tells Python that the data inside are strings.

```
SSID = “YOUR WI-FI SSID”
PASSWORD = “YOUR WI-FI PASSWORD”
API_KEY = “YOUR YOUTUBE API KEY”
CHANNEL_ID = “YOUR YOUTUBE CHANNEL ID”
```

Save the file to the Raspberry Pi Pico as secrets.py and now we can move on to the main section of code.

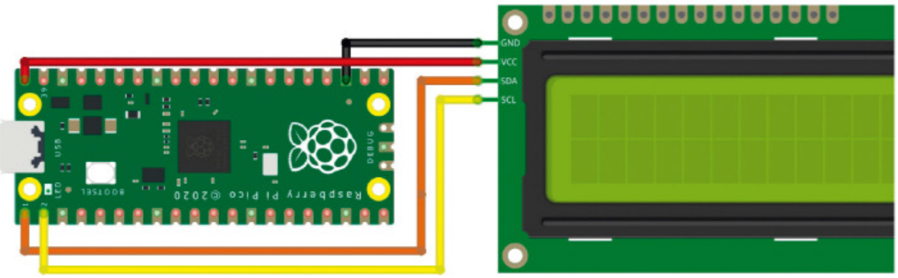
Create a new file and start importing the modules of MicroPython code needed to make the project work. Network connects our Pico W to the internet, secrets is our file containing passwords and API keys. Time controls the pace of the code, urequests and ujson are used to make web requests using the JSON format. Machine enables our code to talk to the GPIO and pico_i2c_lcd enables the use of the I2C LCD display.

```
import network
import secrets
import time
import urequests
import ujson
from machine import I2C, Pin
from pico_i2c_lcd import I2cLcd
```

The next bit of code handles setting up our screen. We need to tell the Pico where it is on the I2C bus. We are using the I2C channel 0 and we need to find the device on the bus. Each device has a unique ID so we'll scan the bus, get the address, then use it to connect. Then we tell the LCD module that we have a screen with two lines, 16 characters wide. Lastly we turn on a blinking cursor to confirm the connection is made.

```
i2c = I2C(0, sda=Pin(0), scl=Pin(1), freq=400000)
I2C_ADDR = i2c.scan()[0]
lcd = I2cLcd(i2c, I2C_ADDR, 2, 16)
```

Now we need to tell the Pico W that we want to get online, and what SSID and password it needs. The five-second sleep is optional, but we find it increases the chance of a good connection. Finally we print the connection status to the Python Shell.



Just four wires connect the large LCD display to the Raspberry Pi Pico W via an I2C interface.

```
wlan = network.WLAN(network.STA_IF)
wlan.active(True)
wlan.connect(secrets.SSID, secrets.PASSWORD)
time.sleep(5)
print(wlan.isconnected())
```

We create an object to store the URL of the YouTube API service.

```
YOUTUBE_API_URL = ‘https://www.googleapis.com/youtube/v3/channels’
```

Create the start of an exception handler process. This tries to run any code within it; any issues (exceptions) are handled later. The first part of the section is a while True loop to continually run the code.

```
try:
  while True:
```

Using an object, url, we need to create the custom URL that contains our YouTube API URL, channel ID and API key. We drop this information into the string using Python's F-strings formatting:

```
    url = f’{YOUTUBE_API_URL}?part=statistics&id={secrets.CHANNEL_ID}&key={secrets.API_KEY2}’
```

Using this crafted URL, we use urequests to get the info from the YouTube API and store it in response:

```
    response = urequests.get(url)
```

If we get a good response (HTTP 200), the info inside response is parsed using JSON formatting:

```
    if response.status_code == 200:
      data = ujson.loads(response.text)
```

We want to extract just the subscriber numbers. As the data is stored using JSON, we need to drill down to the specific value using a series of keys:

```
      subscriber_count = data[‘items’][0][‘statistics’][‘subscriberCount’]
```

We print the subscriber count to the Python shell:

```
      print(“Subscriber count: “ + subscriber_count)
```

To display on the LCD , we first need to turn on the backlight, then put a string of text on the top line: “Subscribers”. The \n is a Python escape character to start a new line after this string:

```
      print(“Subscriber count: “ + subscriber_count)
      lcd.backlight_on()
      lcd.putstr(“Subscribers\n”)
      lcd.putstr(subscriber_count)
```

If there is a response other than HTTP 200, the else part of the code activates, printing a message to the Python shell, before waiting one hour (3,600 seconds), clearing the LCD screen, then the main loop repeats:

```
    else:
      print(‘Error fetching data from YouTube API’)
    time.sleep(3600)
    lcd.clear()
```

The final part of the code is the exception handler:

```
except Exception as e:
  print(f’An error occurred: {e}’)
```

Save the code as main.py to the Pi Pico. In Thonny, click on the run button to test the code. ■

GET THE PICO W ONLINE – GRACEFULLY

In the project code, we were a little basic in how we connected to Wi-Fi with the Pi Pico W, so let's make something a little better.

We start by creating the wlan object and activating the Wi-Fi:

```
wlan = network.WLAN(network.STA_IF)
wlan.active(True)
```

If there is no connection, the response is False. The Pico W tries to connect again:

```
while wlan.isconnected() == False:
  wlan.connect(SSID, PW)
```

It prints the connection status to the Python shell and to the LCD display, before sleeping for two seconds, then clearing the LCD:

```
  print(“No connection”)
  lcd.putstr(“No connection”)
  sleep(2)
  lcd.clear()
```

If the connection is made, the else condition activates, creating an object, ifconfig, to get connection details:

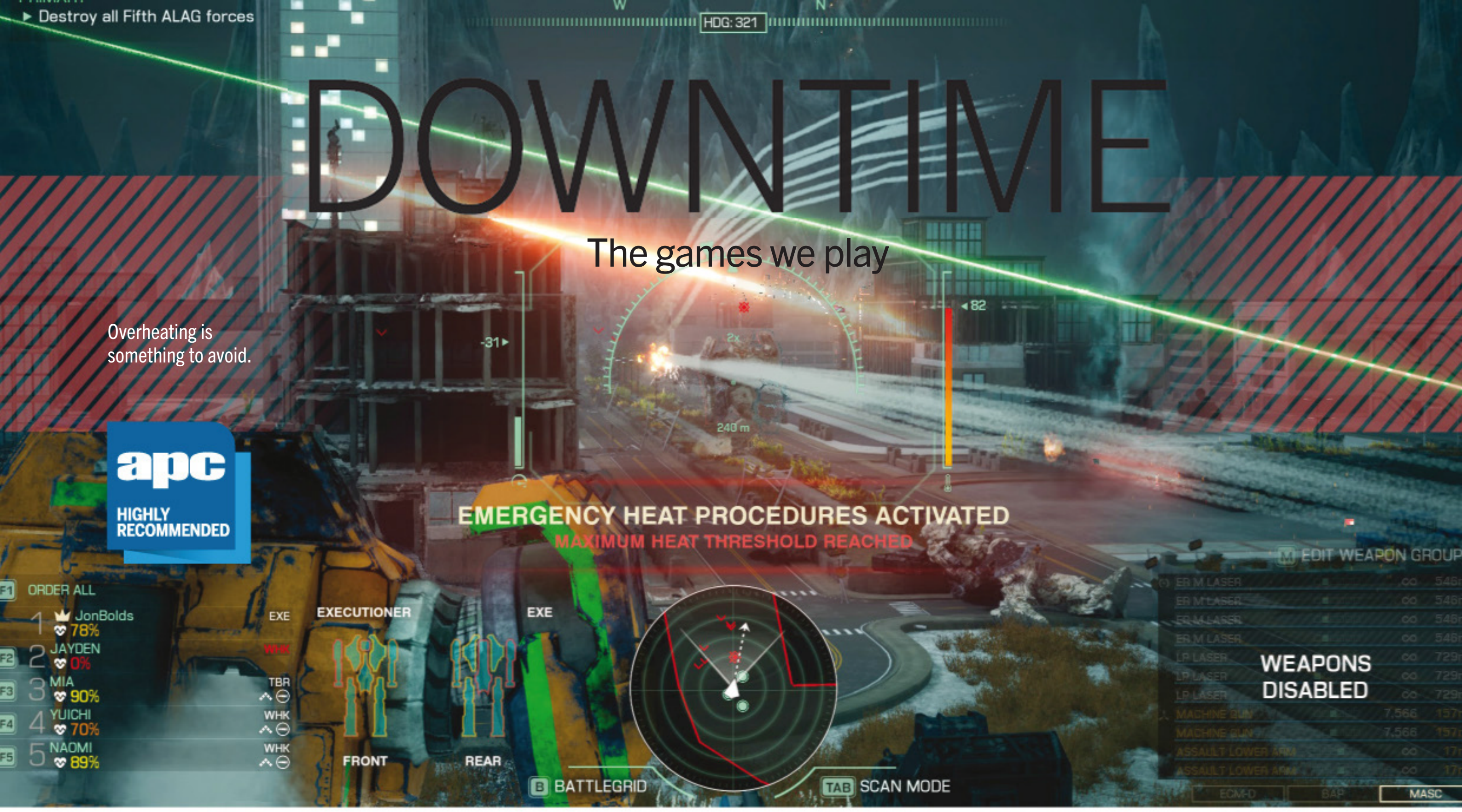
```
  else:
  ifconfig = wlan.ifconfig()
```

We turn the LCD backlight on and print the IP address to the Python shell and display, before sleeping for five seconds and clearing the LCD.

```
  lcd.backlight_on()
  print(ifconfig[0])
  lcd.putstr(“IP ADDRESS”)
  lcd.putstr(“\n”+ifconfig[0])
  sleep(5)
  lcd.clear()
```

DOWNTIME

The games we play



Overheating is something to avoid.

apc HIGHLY RECOMMENDED

PRICE $73.50 **PLATFORM** PC, PS4/5, XB1/S/X **WEB** MW5CLANS.COM

MechWarrior 5: Clans

The venerable mech sim innovates.

***MechWarrior* is back and going harder than ever with a completely standalone game confusingly titled *MechWarrior 5: Clans*, some five years after *MechWarrior 5: Mercenaries*. It's the classic campaign of mech-tweaking and smashing enemies, but *Clans* is a bold game that improves on the classic sim-lite action of *MechWarrior* by adding a more modern, story-driven framing.**

That setting matters more than before. *MechWarrior 5: Clans* does something quite new for the series: it attempts to give you the kind of story found in the *BattleTech* books and novels, which have kept mech-heads invested in this world of space nobility and war machines for decades.

The campaign follows a group of newly-proven teen MechWarriors, all of whom are artificially birthed products of their Clan's genetic engineering program and a brutal training regimen that has left them as the handful of survivors from their family of a hundred experiments – their 'Sibko'.

The iconic Timber Wolf, or MADCAT, makes its return.

What definitely still makes up most of your time is stomping around in mechs picking fights with the locals. Clan mechs are advanced machines far ahead of what the Inner Sphere fields, and missions will see your squad go up against many times their number in not just mechs but BattleTech's many cool vehicles, aircraft and, to my delight, its iconic armed dropships.

For the first time in a *MechWarrior* game I played several missions that felt like my character was part of a proper war between armies where dozens of units on either side clashed amid the chaos of incoming artillery with aerospace fighters streaking overhead.

Mechs are a pleasure to handle in *Clans*, with your machine's facing, throttle, and controls once again the centrepiece of combat. Even though on simpler control schemes your mech plays like an FPS character, its height and the physical placement of its guns really matter.

This is the best that handling a mech has ever felt in a game, though it's at times undermined by anaemic sound design for footsteps and explosions. It feels like each new mech you pilot has its own quirks in movement. There's also how your weapons are differentiated: a gauss rifle and a particle projector cannon feel very different based on how fast the projectile moves and drops at distance. Short and long-range missiles have their own very clear flight patterns to master. I'm playing *MechWarrior* for this kind of simulation fidelity, and it carries the day more than ever.

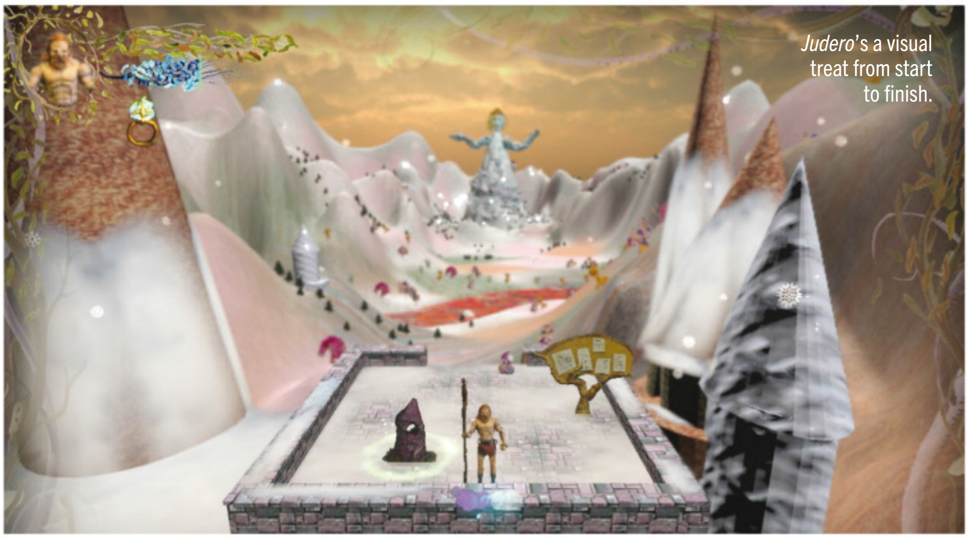
I spent about 40 hours with the campaign before I had only optional objectives in replays to do, and though the lack of sandbox play is most felt when you're still itching for more at the end I still loved the bombastic cinematics and intimate character moments that *Clans* chose over endless procedural content.

VERDICT

★★★★☆

MechWarrior 5: Clans delivers a story of struggling young warriors alongside its iconic mech combat.

Jonathan Bolding



Judero's a visual treat from start to finish.

PRICE $26.50 **PLATFORM** PC, Mac **WEB** tinyurl.com/APC541judero

Judero

Battling faeries, beasties and Englishmen.

"Weirdness" can often feel like an affectation. *Judero* could have only been made by Talha Kaya and Jack King-Spooner, two independent developers who crafted a vision of the Scottish Borders entirely out of action figures and modelling clay. *Judero* is a game with the kind of rough edges and pleasant surprises that could only come from an artistic vision, and it's one that will continue to stick with me.

Judero casts you as the titular Judero: a rough-hewn warrior-priest clearly crafted out of Milliput and a GI Joe action figure. *Judero* uses real, physical models for its digital assets: full-on stop motion in its cutscenes while the gameplay uses sprites in 3D environments like the original *Doom*. The music is also a real treat: acoustic guitar-driven folk tunes that set a nostalgic mood and dovetail with *Judero*'s pagan, earthy influences.

The result looks like *The Last Voyage of Sinbad* but more deliberately uncanny: the characters are all misshapen and rough-cut, with bulging eyes and cratered flesh, but it's somehow not a horror show. *Judero*'s characters are unsettling but not unpleasant, ugly-cute and strangely charming. That appeal is bolstered by *Judero*'s writing.

When you enter houses in the towns, the art style shifts to dreamy watercolours, and the residents inside seem unstuck in time.

Judero's combat is easily the weakest part of the experience: it has poor feedback in general, with hits on enemies feeling weightless, the perspective often making it a chore to line-up attacks, and many enemies having aggravating, multi-part stunlock moves. At its best, the brawling is adequate connective tissue, another thing to do while wandering over hill and dale.

Judero is the kind of indie game that's really worth celebrating. It's funky and has some rough edges, but that comes with the territory for such a unique labour of love. *Judero* isn't a transcendent action game or a next-level puzzler, but those aspects are good enough to support its real draw: a thoughtful, strange world and incredible aesthetics.

VERDICT

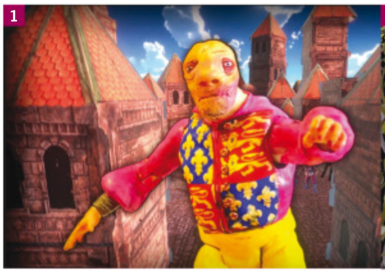
★★★☆☆

Peak indie game: funky, weird, rough and wonderful in a way only such a small, ambitious project could be.

Ted Litchfield

1 What a well-dressed fellow he is.

2 Some of *Judero*'s most fearsome foes: the English.

1


2

PRICE Free **PLATFORM** PC
WEB bit.ly/FuneralLastDays

FUNERALOPOLIS: LAST DAYS

REFLECTING ON HORROR

This weird game begins on the periphery of your oppressive, Brutalist city, but gradually inches closer to home as you tune into your radio and peep out the window at the other tower blocks. When was the last time you saw the sun? What's all this chatter about a mysterious substance discovered in a local mine? Why is the church taking people from that tower block in the middle of the night? There's a tangible, tight-knit atmosphere to the game's small yet richly detailed environments, which comprise your apartment and office, and the dingy hallway where the other residents occasionally gather.

You're the overseer of the complex, by the way, so it makes sense that the residents knock on your door, with their expressive yet low-res textured faces. So many faux-retro games look like early PlayStation titles, but *Funeralopolis* reflects the 32-bit era at its prime. Considering its detail, its gloomy atmosphere, and how thoroughly you'll explore the setting, this is one of the most immersive games I've played in a long time.

VERDICT

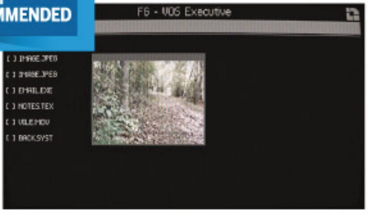
★★★⯨☆

An immersive horror game that renders an intimate setting in great detail. Beware the man in the mirror…

Tom Sykes

F6 - VOS Executive
PAUSE
BACK
RAINBOWY PERFUME

apc HIGHLY RECOMMENDED



F6 - VOS Executive
PAUSE
BACK
Electronic Mail Mailbox
NEW ELECTRONIC MAIL MESSAGES!
the real Candy? Man
I have attached the

FILE CORRUPTED

NO VIDEO

- No way. I can't believe I'm meeting you. -

PRICE Free **PLATFORM** PC
WEB final-girl-games.itch.io/vile

VILE

AN APTLY NAMED PC INVESTIGATION GAME.

Rooting around in someone's computer/phone' has become a genre unto itself, with even the most innocent examples making you feel like you're invading someone's privacy. That thought never occurred to me as I explored the contents of Vile's PC, as there are secrets here that need to be brought to the light. As you click on .exe files and emails and visit the websites frequently haunted by the owner, it quickly becomes clear that he's a piece of shit. He's obsessed with a (fictional) actress named Candy Corpse who has starred in several extreme horror films, and he posts on a fan forum dominated by creepy stalker talk. This is a story that only gets darker as you pull at the threads, putting on your deerstalker to discover passwords that will let you into the shadowy recesses of a vile individual's life. Still, I'm glad I found my way to the powerful ending, which is all the more horrible as you've spent the last half-hour effectively in the individual's shoes.

VERDICT

★★★★☆

Vile stands out as the rare horror game with something to say.

Tom Sykes

One thing *Extermination* communicates well is the size and bulk of the arachnids.

apc EDITOR'S CHOICE

PRICE $74.99 **PLATFORM** PC, PS5, XBS/X **WEB** tinyurl.com/APC541troop

Starship Troopers: Extermination

Buggy and occasionally bloody brilliant.

Compared to the seemingly similar *Helldivers 2*, *Starship Troopers: Extermination* is a surgically precise slapstick comedy. *Extermination* is a much broader, weirder, rougher affair.

Extermination's main event is its 16-player cooperative missions, in which four squads of four players work together to withstand the arachnid menace for the glory of the Federation. If the idea of building a base with 15 strangers sounds either tedious or intimidating to you, in my experience with *Extermination* it is neither. Bases are fully kitted out within minutes, as players work efficiently together to erect walls, place reinforced bunkers, situate ammo dumps, and station manned and automated gun turrets.

Once the base is constructed (or in some missions, while the base is under construction) the arachnids will start attacking. Combat is slower and less refined than most modern FPS games, but it still feels great to fill an encroaching arachnid with lead, especially if you find a class you jive with. Players can assume the role of snipers, grenadiers, and flamethrower-toting engineers, each of which have their own weapons and abilities. Personally, I found myself partial to the Guardian, who comes equipped with a heavy assault rifle with a large magazine as standard, and can deploy a metal ring-fortification around themselves at will. Not only does this provide cover from projectile-shooting bugs, it also temporarily stops arachnids in their tracks, which is extremely handy when trying to hold a position.

Extermination's biggest letdown is the recently added solo campaign. This sees you join a Special Operations Group overseen by Johnny Rico on a side-adventure comprising 25 missions. Unfortunately, these missions are terrible. They all take place in murky, seemingly randomly generated tunnels with basic objectives ripped from the multiplayer and little in the way of actual craft.

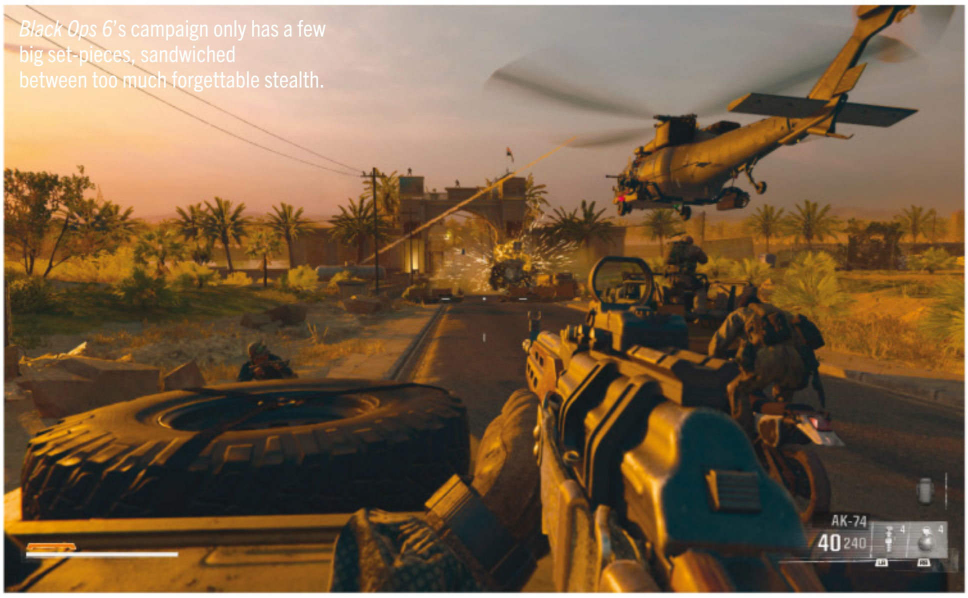
Add more maps, modifiers and a heavy dose of refinement to Extermination's existing framework, and I reckon it would be a great multiplayer game. As it is, it's still a good one, but undeniably flawed.

VERDICT

★★★☆☆

Starship Troopers: Extermination's cooperative battles are mechanically innovative and can be great fun.

Rick Lane



Black Ops 6's campaign only has a few big set-pieces, sandwiched between too much forgettable stealth.

PRICE $109.95 **PLATFORM** PC, PS4/5, XBS/X **WEB** www.callofduty.com/au/en/blackops6

Call of Duty: Black Ops 6

Belligerently enjoyable.

At some point when I wasn't watching, *Call of Duty*'s campaign became a bad stealth game. Gone are the perspectives of the faceless soldiers, replaced with characters who look and feel like they came from a Netflix Original movie. When *Black Ops 6*'s campaign occasionally channels the bombastic scope of its predecessors, it rocks, but all too often it's bogged down in tedious espionage.

I don't accept that the largest videogame franchise on the planet, especially with such a rich history of incredible single-player campaigns, should be so thoroughly mediocre. *Call of Duty* used to at least have an engaging perspective, putting you in the hot seat of the turning-point battles of the near-modern world, but *Black Ops 6* offers nothing like that.

For all my gripes about the campaign, my annoyance melts away in the face of the multiplayer, where *Black Ops 6*. seriously delivers. *Call of Duty* has never felt better in the hands, owing largely to the new Omnimovement system, which lets one sprint, slide and dive in any direction. It's a major reason why *Black Ops 6* feels so good to play, bringing a satisfying sense of weight and momentum to a series that spent the last decade teeter-tottering between boots-on-the-ground and full-on jetpacks.

I've been generally pleased with the maps this year as well, which have become a point of consternation among players. I've also fallen head-over-heels for Kill Order, a spin on *Black Ops – Cold War*'s VIP mode which randomly selects high value targets on both teams and grants them armour, Last Stand and a persistent UAV. The goal is to rack up a higher HVT killcount than the other team, and each match consistently leads to some of the most engaging and dynamic firefights I've had in multiplayer *Call of Duty*.

Though my heart may yearn for a bygone campaign era, one that was more ambitious, thoughtful and considered, *Black Ops 6* just feels too good to put down.

VERDICT

★★★½☆

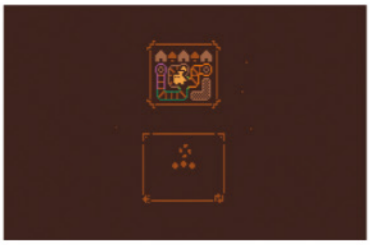
Call of Duty's strongest multiplayer offering in years is dragged down by a tedious campaign.

Nova Smith

1 A protracted semi-open-world mission set in Iraq is very nearly the campaign's lowest moment.

2 The Zombies tie-in mission Emergence is a worst-ever *Call of Duty* level.

Some of these tracks are so damaged!



PRICE Free **PLATFORM** PC, browser
WEB kultisti.itch.io/raide

RAIDE

CHOO CHOO CHOOSE THIS PUZZLE GAME.

Raide is a game of intimate, tactile puzzling and unravelling secrets. If there is a big idea – some mechanic that sets it apart from the other train-based puzzle games – I haven't found it. The rules of the game are simple: you're laying track segments between distant points, to connect houses together. In each level, you're given a pile of track bits, and you must use every piece in the puzzle, even if a simpler solution presents itself. These rules are soon embellished with track-splitters and broken track, and I had a challenging, engrossing time playing through the main story this evening.

It's engrossing not just because of the clever-yet-fair puzzles, but because this is a wonderful little world to be in, with pixel art that tells you everything in only a thimble's worth of colours and pixels, and puzzle pieces that feel satisfying to pick up and place. The music also does a lot to build up the cosy, mysterious atmosphere, setting the perfect tone as you try to peck out the game's secrets.

VERDICT

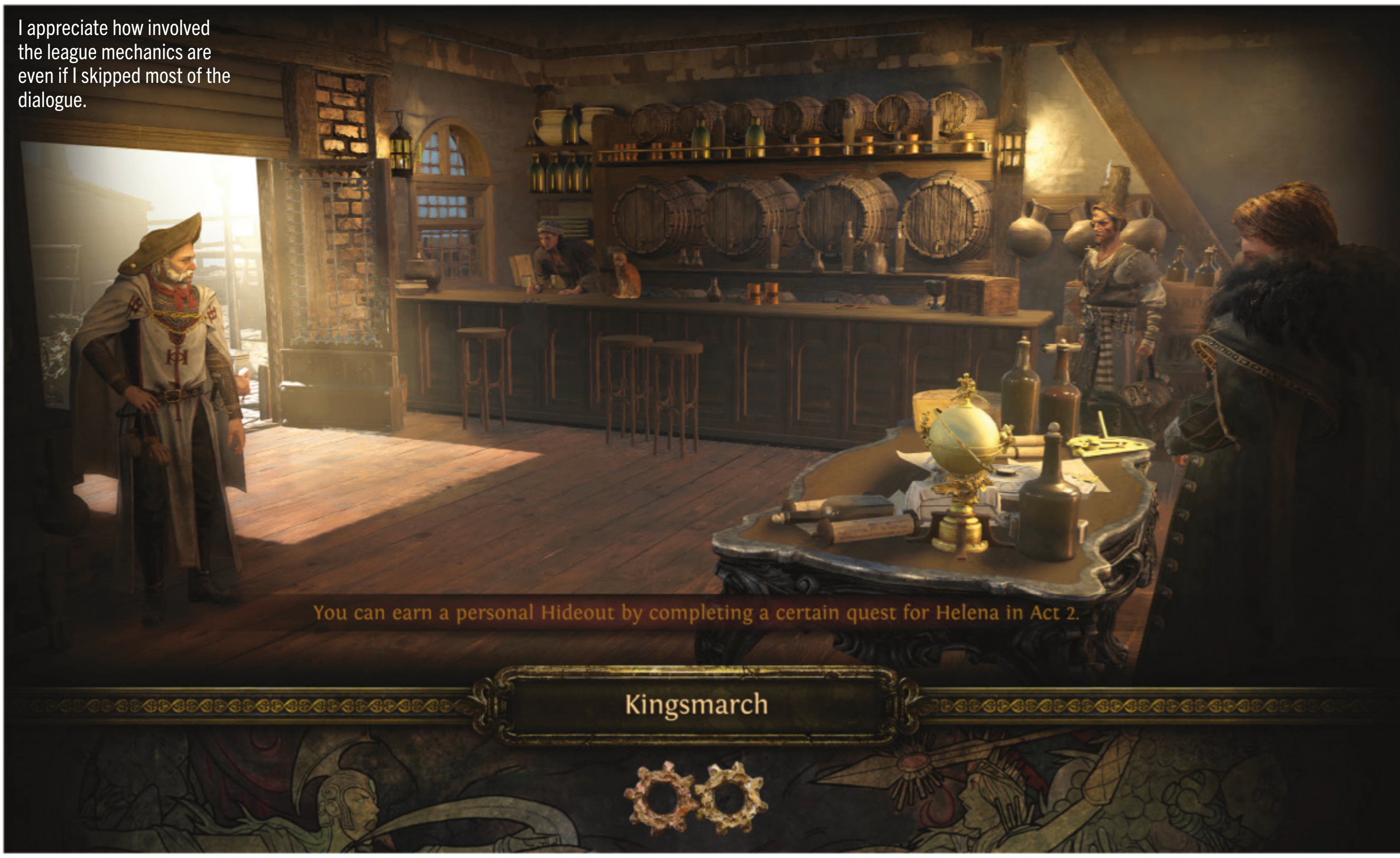
★★★½☆

There is more to *Raide* than meets the eye. Sit down with a cuppa and get to work.

Tom Sykes

GAME CHANGER

Old games, new perspectives


You can earn a personal Hideout by completing a certain quest for Helena in Act 2.

I appreciate how involved the league mechanics are even if I skipped most of the dialogue.

RELEASE October 23, 2013 **DEVELOPER** Grinding Gear Games **PUBLISHER** Grinding Gear Games **LINK** pathofexile.com

Path of Exile

Tyler Colp wraps his head around the most complex action RPG.

I thought I was prepared for *Path of Exile* after spending the last year knee-deep in *Diablo IV*, but it turns out I'm still not strong enough. No matter how many times I've tried to get into it I can never seem to spend more than a handful of hours lost in its maze of mechanics. That's not to say it's a bad game by any means; I just don't think *Path of Exile* is for me.

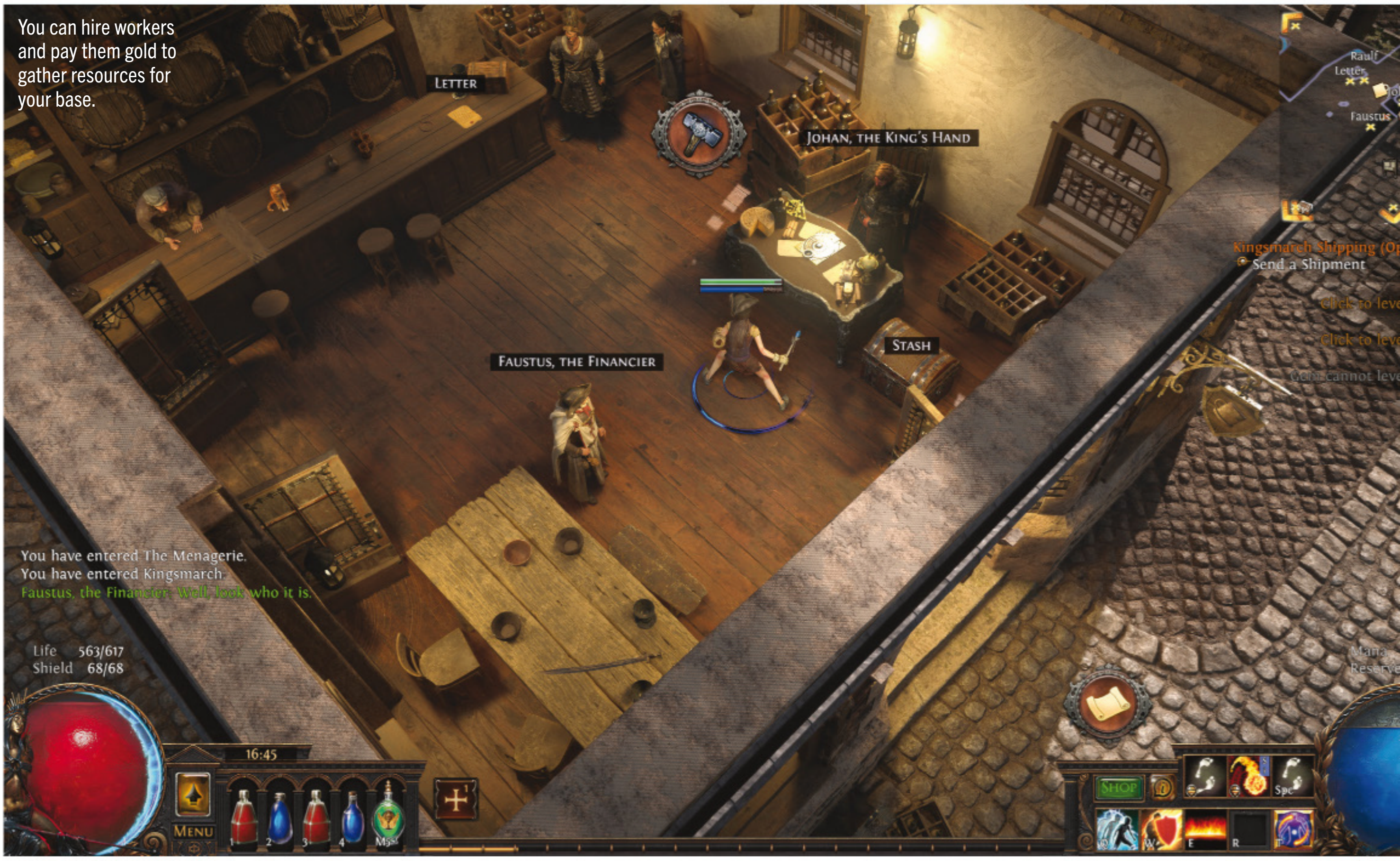
This attempt was the most successful and I'll admit that it made me appreciate the kind of action RPG Grinding Gear Games is going for with *Path of Exile*. Compared to *Diablo*, *Path of Exile* is extremely balanced, in a way that makes every small upgrade feel meaningful. *Diablo*, on the other hand, showers you in upgrades and is largely an RPG about stacking bonus after bonus on top of each other until you've become a demon-slaying god.

For this run, I gave in and followed a guide for a 'league starter' build, which is essentially a setup made to make the early parts of the game easier. *Path of Exile* is surprisingly hard when you're starting fresh in a new League, its name for seasons. Enemies can knock your health down to zero if you're not careful and item upgrades are slow to come by. Starting off with a build that has even a little bit of synergy can make the early part of your journey to level 100 much smoother than it would be trying to figure everything out on your own.

I'm totally OK with following a build guide in a game I don't fully understand. Having a clear explanation for what kind of items to look for and which skills to use gives me a peek into how the game works – knowledge you can then apply to things you want to do differently than a guide down the line. It's how I learned so much about how *Diablo IV* works. I appreciate websites like Maxroll that put in a lot of effort to make these complex games approachable to people who get overwhelmed by the tidal wave of numbers and skills that crashes into you in the first few hours.

So I made a witch, and woke up on the beach at the start of every *Path of Exile* character's journey. The plan was to level-up enough to ascend into an elementalist and pick up the Frostblink skill to teleport through the game. In *Path of Exile*, you have to finish the campaign in every new League. Instead of telling myself I'd take the time to appreciate the story, I went in with the plan to skip everything and just play the game.

I barely even understand the reason for why the unique Settlers of Kalguur League mechanic involves building a base so you can hire workers and send them across the sea to trade materials. The game kind of throws you directly



You have entered The Menagerie.
You have entered Kingsmarch.
Faustus, the Financier: Well, look who it is.

You can hire workers and pay them gold to gather resources for your base.

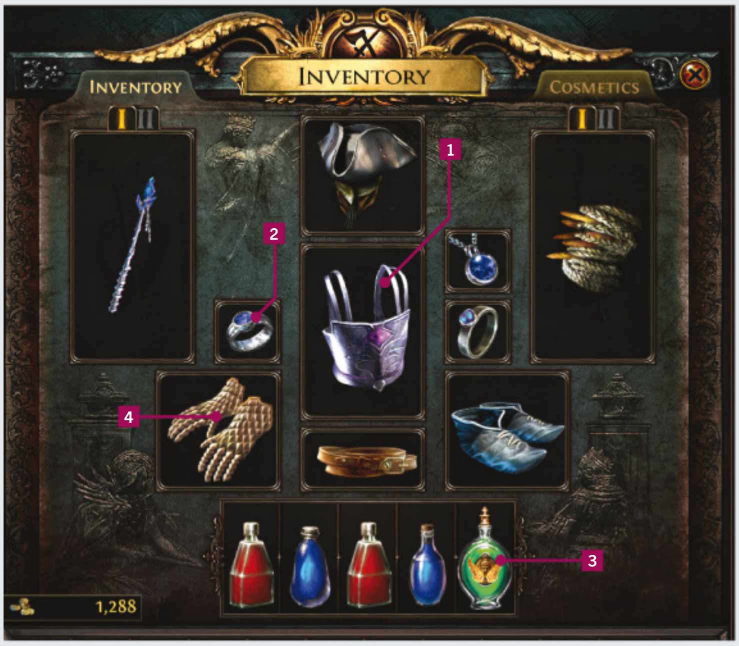
into it and expects you to understand why it'll matter in the long run, which I did not. The League mechanic doesn't seem to be the thing that keeps people logging in every few months to do everything over again.

The long climb

No, the real draw of *Path of Exile* is clearly how satisfying it is to build your character up with every new piece of loot. The fact that your skills drop like loot and have to be socketed into your gear gives every monster kill the potential to change everything about your character. *Diablo IV* has this as well but it isn't as necessary. The edge you'd get over another player for adapting to a particular item drop early on in your journey isn't very significant compared to what it's like finding something powerful in *Path of Exile*.

I didn't have a lot of luck with godly items showing up far earlier than they should, but I was able to create a fairly survivable character with what I had. I juiced up my fireballs and exploded my way through a good chunk of the campaign. Dungeons are dense and take some time to get through while you're still slow and weak. It's clear to me now how much *Path of Exile* wants to emulate the methodical pace of *Diablo* games.

SUIT UP *What ten hours of PoE looks like*

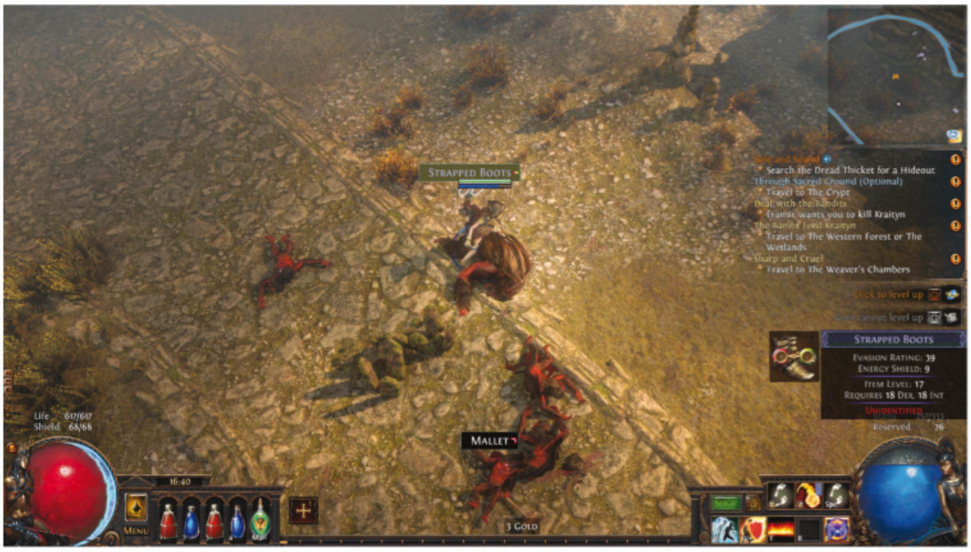


1 GOLEM VEIL
This piece contains the sockets for my rolling magma skill and the two gems that increase its damage.

2 SAPPHIRE RING
You can go for hours in PoE without finding anything better than a bad grey item.

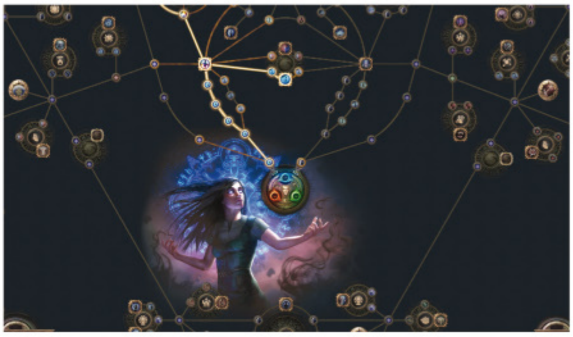
3 QUICKSILVER FLASK
Everything changed when I found this potion that gives me a huge speed boost whenever I drink it.

4 STALWART IRONSCALE GAUNTLETS
These gloves may not look like much but they hold a gem that regenerates mana.



TOP RIGHT: A loot filter for only displaying items worth picking up is essential.

RIGHT: The skill tree is a lot but it's actually split up into clear sections.



Rog, the Disenchanter
Sell Items
Goodbye

I spent close to an hour in a damp cave full of so many twists and turns that I kept getting lost trying to find the exit. In a way, it was kind of charming to have to actually pay attention to the layout and search for the right path through. *Diablo IV* dungeons are designed to get out of your way, which leads to them feeling more like battle arenas with hallways. *Path of Exile* isn't about blasting until you're much higher level.

And to an extent, that's my issue with it. *Path of Exile* is just a little too slow for my taste. While I could tell my little witch was growing stronger with each piece of loot, I got tired of casting fireball after fireball and looting gear with three more health. If you want a game that gives you that low level MMO experience where you spam the same spells waiting for that upgrade that changes everything, *Path of Exile* is for you.

Not about that life

I'm not that person. However, I think my time revisiting *Path of Exile* helped put my love of *Diablo IV* into perspective. It's not just how grippy the combat in Blizzard's action RPG feels, it's the speed of progression. You don't have to spend very long for your character to start crushing demons like soda cans. The most challenging dungeons are optional, letting new players have their fun and experienced players push themselves to see how far they can go.

But my weekend with *Path of Exile* also made me more excited than ever to try *Path of Exile 2*. The trailers for it suggest that the early game will mimic Soulslikes with slow animations and long boss fights. You won't be running through forgettable enemies until the endgame where everything suddenly matters: *Path of Exile 2* wants to frontload the challenge and loosen up hours later.

I could easily see *Path of Exile 2* finding a niche for players like me who prefer the speed of a *Diablo* game but want something to contrast it when I've finished everything I want to do in its latest season. I didn't hate my time with *Path of Exile* but it ultimately just felt too slow, like there wasn't enough meat on its bones. If the sequel gives me a lot to chew on for those first 40 hours, I could easily see myself as someone who splits their time between both games.

Even though I never ascended into an elementalist and frostblinked through *Path of Exile*'s campaign, it's clear that *Diablo* can't replicate having such a tight connection with your character. Right now, I can still remember my rotation of skills and the sizzle of my witch's bouncy fireballs. The friction makes a lot of it stick with you whereas *Diablo* characters can slip out of my mind once I'm done playing them.

Path of Exile may be an old game at this point but it's still got it. I used to wince at the massive skill tree that scares a lot of people off. Now I totally get it: no game is as flexible and expertly balanced around the idea that the tiniest upgrades can make the biggest impact. A younger me with more time to play would've thrived on the complexity.

That isn't the kind of gaming life I lead today, but I can totally see the vision and hope *Path of Exile 2* is my ticket in. ■

RETRO

Inspirational stories from computing's long-distant past

Sony's 1994 PlayStation with the iconic control pad.

Sony PlayStation: the game changer

David Crookes looks at how the first PlayStation turned the gaming world on its head, impacting rival console manufacturers, videogame developers and the perception of games themselves.

In December 1994, it was becoming clear where gaming was heading: straight down the road to the third dimension. Although 3D games had been around for a while – DOS titles *Wolfenstein 3D* and *Doom* being the most notable – one play of *Ridge Racer* was all it took to convince larger numbers of gamers that 3D was the future.

Ridge Racer was a launch title for Sony's PlayStation, a console that had made its debut in Japan. As history will attest, this machine forever changed the course of the videogame industry by successfully smashing the long-held Nintendo-Sega duopoly. It drove forward with fresh thinking and a determination to turn the industry on its head. In short, the PlayStation was a game changer.

It could have been so different. Six years earlier, Sony had no desire to become a major player in the console market. Instead, it partnered with Nintendo to create a CD-ROM add-on device for Nintendo's 16-bit SNES called the Play Station (with a space between the words).

Yet when Sony announced the partnership during the 1991 Consumer Electronics Show in Las Vegas, Nintendo poured cold water on the deal. It said it had signed a separate arrangement with Philips for a CD-i add-on, and it was later confirmed that the Sony-Nintendo project was off. Understandably annoyed, Sony decided to go it alone with a product that would eventually go head to head with its former partner. The desire for revenge appeared strong.

Ken Kutaragi, who had worked his way up at Sony having started in the company's digital research labs, was tasked with heading the new console project, and the resulting PlayStation emerged with some very impressive stats.

The new console had a 32-bit R3000A processor clocked at just over 33MHz. It could also offer 2MB of RAM and 1MB VRAM, plus 16-bit, 24-channel sound and the ability to play audio CDs. But the PlayStation became much more than a list of technical specifications.

> "Sony decided to go it alone with a product that would go head to head with Nintendo. The desire for revenge appeared strong"

Gaming grows up

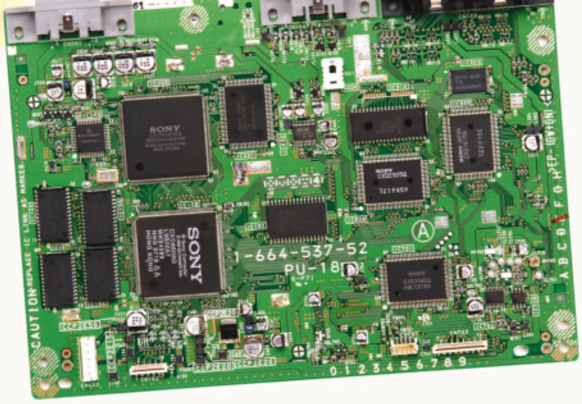
As it happens, by the time Sony released its console, Nintendo wasn't its main concern. The latter was still selling the 16-bit SNES and its own next-gen machine wouldn't arrive for another couple of years.

Instead, the PlayStation was competing against the Sega Saturn, the successor to the popular Mega Drive console. But while the Saturn got a month's head start on Sony and offered compelling and exclusive titles such as *Sonic the Hedgehog*, the Sony PlayStation ultimately ended up running rings around it.

One of Sony's big decisions was to go all in with a console that played 3D games, and the machine was fast enough to render 360,000 polygons per second. This was in contrast to the Sega Saturn's video chip, which was built with 2D sprites in mind. This gave the impression that Sega still had one eye on the past while Sony's view was on the future.

To ensure the experience could match expectations, Sony knew it needed to get top developers on board who were capable

LEFT: FMV, intros and cutscenes became a staple of many PS games. *Tekken II* is etched into many a memory.



ABOVE The console motherboard included a 32-bit R3000A processor clocked at 33MHz.

of making the most of the technology. It needed to spread the message that this was a console like no other – a consumer device rather than a toy. As part of this strategy, it insisted that every game developer had to banish 2D in favour of 3D.

Sony wanted the console to open up gaming to a mainstream audience, and to transform a largely niche hobby into something cool. And it wanted that to happen wherever the console launched, whether that was in Japan (December 1994), Europe and North America (September 1995) or Australia (November 1995).

To that end, a demo disc contained a giant, walking 3D T-rex that quickly caught people's imagination and became iconic. The aforementioned *Ridge Racer* game was almost indistinguishable from the blistering, chunky-car coin-op arcade original and it, too, served to impress.

Over time, more and more standout games were released including *Metal Gear Solid*, *Castlevania: Symphony of the Night*, *Resident Evil*, *Tekken*, *Crash Bandicoot*, *Gran Turismo* and *Silent Hill*. Some games carried 18-certificate ratings and the message was clear. Gaming was growing up.

In double-quick time, on the back of a series of whip smart marketing campaigns that got people talking (one suggested the power of the PlayStation would corrupt players and turn them into a monkey), gaming came out of the bedroom and began to take pride of place in the living room.

The PlayStation also ended up in bars and nightclubs, primarily on the back of a game by top UK development studio Psygnosis called *WipEout*, the soundtrack of which featured the Chemical Brothers, Orbital and Leftfield. The capital "E" was deliberately stylised as a nod to ecstasy and it further highlighted Sony's targeting of an older, more influential demographic.

"Games like *WipEout* helped get the message out that PlayStation was a game-changer and it was cool to be a young adult who enjoyed playing games," said the game's designer Nick Burcombe. "Rolling the PlayStation out into nightclubs such as Cream was clearly aimed at changing this perception and, as we can see today, it worked."

With great power

"The business model changed dramatically because of the transition from cartridge to CD," said Ray Maguire, the former managing director of Sony Computer Entertainment. "The cartridge model required a commitment in terms of units ordered and payment was back-to-back letters of credit. Delivery would also run into weeks because production was in Japan.

"All of this meant you had to get the forecast right to maximise profit. Too small a forecast, and you'd risk running out – the delay in getting more stock could mean the consumers might buy other games instead. Too large, and you'd have to discount the games to clear, writing the remaining stock down. CD production could be turned around within days rather than months. Retailers loved this 'just in time' model for PlayStation games."

The move to CDs also meant that games could be bigger and more detailed because their capacity was far larger than cartridges. Because of the lower cost of CDs, some titles could span as many as five discs. "It gave developers the ability to create bigger and better games," Maguire said. "Simply put, the more pixels you use, the more detail you get. Better definition opened up the options for developers to create games that couldn't be made before."

To encourage developers to climb aboard, Sony assisted with a range of tools and documentation, and it provided development kits well ahead of the console's intended release. Sony bought Psygnosis, previously known for making *Lemmings* and *Shadow of the Beast*, and the studio suggested working with SN Systems to create an inexpensive development system that would run on PCs with two extension boards attached.

This opened up the scope of development and, as David Darling, former boss of Codemasters and now CEO of Kwalee, told us, Sony proved to be very accepting of new studios right from the start. "Sony was much more welcoming as a platform holder than others that had come previously," he said. "They welcomed developers like us with open arms – Phil Harrison and the other guys really helped coach us and gave us all the development tools that we needed."

Harrison had joined Sony Computer Entertainment Europe as executive vice-president for development in 1992, and he became vice president of third-party

ABOVE: *Tomb Raider* made its debut on the Sega Saturn but was best known as a PlayStation title.

"In double-quick time, gaming came out of the bedroom and began to take pride of place in the living room"

relations and research and development for Sony Computer Entertainment America from 1996. He would visit development studios to present the PlayStation, explaining what it could do and the type of games that he felt would be desirable and work well.

"I think one thing people forget about the launch of PlayStation was Phil's role," said video game designer David Perry, founder of Shiny Entertainment. "Sony had a 'front man', someone who went out to sell the product, and he did it well. I remember him visiting our offices in Laguna Beach and showing us the famous dinosaur demo. We were all amazed, thinking, 'Wow! Are we really going to be able to do that?'"

Levelling up

This approach was very different to how Sony's rivals approached development. "It [Sony] had its own dedicated dev conferences, attended by hundreds of developers and we all had great account managers and technical staff on hand to help with any difficulties," said Andrew Oliver, former CTO of Blitz Games Studios

"With Nintendo, you were either in their Dream Team or you were an outsider, and that made it a lot harder to develop for its consoles. Sega was in between. It had the aspirations to be as welcoming as PlayStation but never had the budget and PlayStation was taking all the great staff.

"Sony's goal was to help every developer make the best games possible and, while Sony itself had decided to actively capture an older demographic, it had bought *Crash Bandicoot* and *Spyro the Dragon* to compete with *Mario* and *Sonic*. It gave huge budgets to these studios to make much more mature games as well."

Despite all this, there was still much pain being felt in the industry. "A lot of devs struggled to move from 2D to 3D," said Philip Oliver, former CEO of Blitz Games Studios, which released ten games for the debut PlayStation.

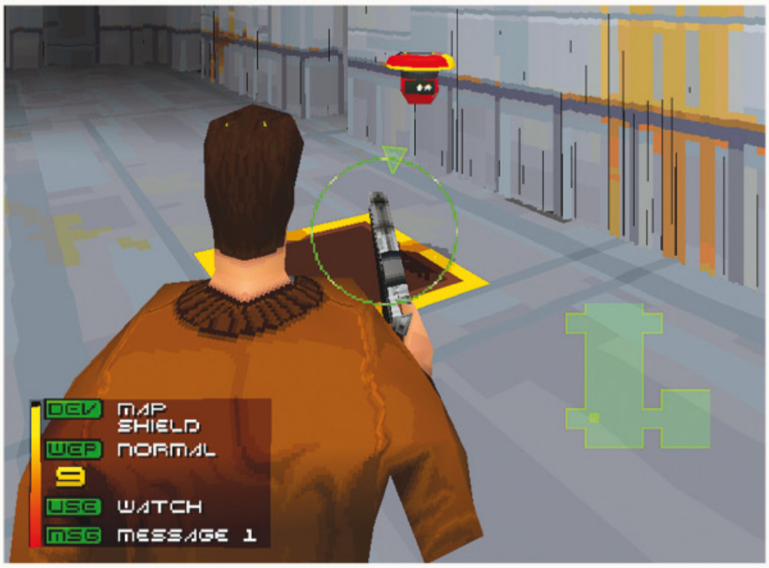
It was a case of adapt or die and, for large numbers of game developers who had spent careers creating two-dimensional games for 8-bit and 16-bit computers and consoles, it wasn't a case of being overawed by the technology but overwhelmed. Some simply lacked the required skills yet found themselves in an industry insisting on it.

"It was new to most of us back in 1994 and it took some learning to adapt," said Andrew Oliver. "Not only did the programmers need to learn new techniques and write new engines, artists needed to change their workflow completely.

"This was a time when they were all happy with DPaint 3 on the Amiga and early Photoshop. Now they had the complex tool of 3D Studio Max, and many struggled with the entirely different type of art required.

"Not only that, we had to get these 3D creations out of that package into our own, newly created 3D engines. It was a challenge yet a challenge we just went for. But there were some studios that were founded on their successful 2D titles and they struggled to get those games on to this new and popular console."

Some difficult decisions had to be made as a consequence. As impressed as Perry had been, for example, it was clear that developing games for PlayStation was a far cry from the early bedroom-coding days



LEFT *Fade to Black* used fully textured 3D graphics.

CHOP
CHOP
COOL
U rappin' GOOD !
BAD
AWFUL
SCORE 0

of the industry. "My studio was drawing games like *Earthworm Jim* with pencils, and moving to 3D meant we needed new computers, new software and a lot of retraining," he said. "I was so concerned about the transition that I ended up selling Shiny to Interplay."

Under the deal, Shiny could continue to create games under the same management and identity. "Luckily, we had people like Andy Astor (who is sadly no longer with us) and Martin Brownlow, who dove into 3D development with full commitment. Thanks to them, we started creating games like *MDK* in 3D, and we successfully made the transition but, looking back, I regretted selling Shiny. PlayStation showed us that 3D was the future, and thankfully, we took it seriously."

Number crunching

Certainly, developing for the PlayStation appeared to be a safer bet than creating for other systems due to sheer numbers. Another rival system, the 3DO – a console manufactured by Panasonic, Sanyo, GoldStar, Samsung and Creative Technology – sold fewer than two million units. The Saturn shifted 9.26 million and the Nintendo 64 sold 34 million. The debut PlayStation went on to sell 102 million.

And those gamers loved to buy games. *Gran Turismo* alone sold 70 million copies, with *Crash Bandicoot* and *Tomb Raider* not far behind on 50 million and 42 million respectively. Or perhaps you remember *Silent Hill* (8.5 million) and *PaRappa the Rapper* (2.2 million). Developers released more than 4,000 PlayStation games, with cumulative sales of 962 million. And what is perhaps just as remarkable, Future Publishing's *Official PlayStation Magazine* reached a circulation of 453,571 thanks, in part, to its monthly cover discs packed with game demos.

The release of the Net Yaroze dev kit in 1997 marked another big landmark. By this time, Sony had relaxed its 3D rule, and this, together with the dev kit, made it easier for one-man bands and small teams to create standout games such as *Blitter Boy: Operation Monster Hall* and *Haunted Maze*. The kit even helped some devs get a start in the industry: Mitsuru Kamiyama created *Terra Incognita*, went on to work for Square Enix and now has 17 games to his name.

TIME
41
POSITION
12
LAP TIME
0' 16"440
BEST TIME
1' 19"765
TOTAL
2' 43"765
060 km/h

TOP Kick. Punch. It's All in the Mind. *PaRappa the Rapper* was one of the quirkier titles for the machine.
ABOVE *Ridge Racer*: chunky visuals and slick, arcade-like action.

Never underestimated

Over the years, the PlayStation brand became ever stronger. It saw off Sega which, despite developing the Dreamcast, pulled out of the console market long ago. It also caused Nintendo to struggle for a while – neither the Nintendo 64 nor the GameCube could match the PlayStation for sales, and it wasn't until the Wii launched in 2006 that it found its mojo again.

By that time, the PlayStation 2 had chalked up 155 million sales to make it the best-selling games console of all time. And while the PlayStation 3 drew with Microsoft's Xbox 360 in that particular console war, since the launch of the PlayStation 4, Sony has rarely looked back. Its current machine – PlayStation 5 – is outselling Microsoft's Xbox Series X/S by two to one.

"Sony's branding was cool, the PlayStation was powerful, the business model was better and the timing was right," said Burcombe. "All of these things made it successful. Sony is a great brand name in electronics and it jumped into the games business, disrupted it and succeeded in much the same way that Apple jumped into the portable music business and took over. It was amazing to be a part of that era." ■

Determined to find a new use for his old phone, Robert Irvine tries to…

Create a portable file vault

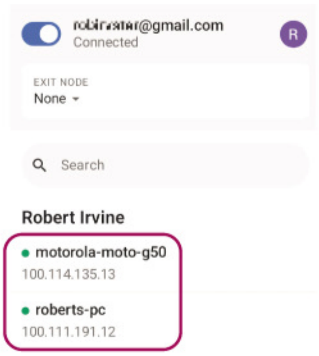
It's that time of year when many of my colleagues are 'abuzz' about the latest iPhone, and the slightly different specifications it has to the previous model. Not me, though – I've sworn my allegiance to Android, and the last time I was abuzz was when a dozy bee landed on my pillow.

I've been buying Motorola phones for the past 10 years, because they offer a decent set of features for an affordable price. My current handset, the Moto G84, has a mighty 256GB of storage, which is more than enough for testing apps for my day job. Its predecessor – the Moto G50 – still works fine, but the battery life isn't great so it's been relegated to my gadget-graveyard drawer.

I came across the old phone the other day and, because I won't get much money for selling it, wondered if I could use it for another purpose – or 'upcycle' it, in the modern parlance. With its 64GB of storage and fingerprint lock, I could turn it into a secure, portable back-up device for important files. But how would I copy over data without faffing around with a USB cable or uploading to 'the cloud'?

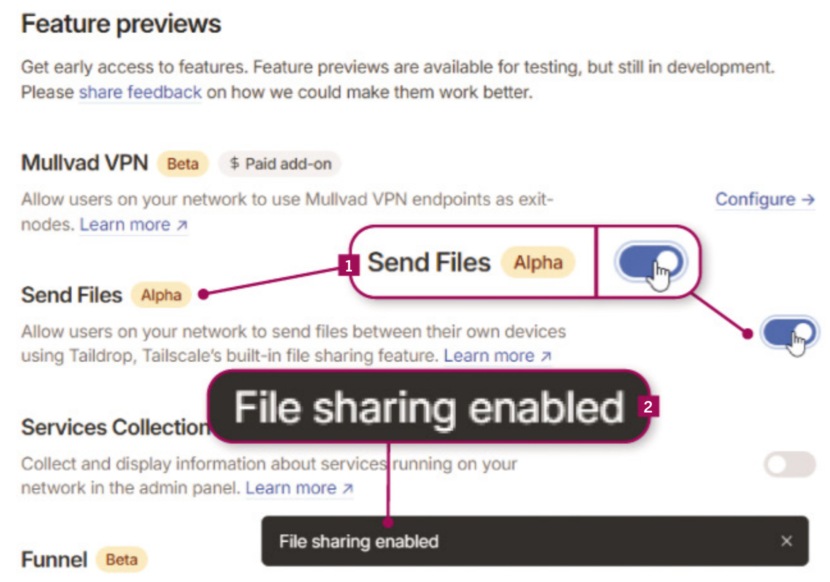
The answer came from a service called Tailscale (**tailscale.com**) and its clever Taildrop feature (**tailscale.com/kb/1106/taildrop**). This lets you transfer files between devices, including from your PC to your phone, over an encrypted network, without any size limits.

I signed up for a free Tailscale account, then downloaded and installed its Windows software (**tailscale.com/download**). Once I'd logged in, I was prompted to connect my PC to my 'tailnet' (Tailscale network), which was as easy as clicking a button.



[redacted]@gmail.com
Connected
EXIT NODE
None
Search
Robert Irvine
motorola-moto-g50
100.114.135.13
roberts-pc
100.111.191.12

Robert easily connected both his PC and phone to his 'tailnet'.



Feature previews

Get early access to features. Feature previews are available for testing, but still in development. Please share feedback on how we could make them work better.

Mullvad VPN Beta $ Paid add-on

Allow users on your network to use Mullvad VPN endpoints as exit-nodes. Learn more ↗ Configure →

Send Files Alpha

Allow users on your network to send files between their own devices using Taildrop, Tailscale's built-in file sharing feature. Learn more ↗

Services Collection

Collect and display information about services running on your network in the admin panel. Learn more ↗

Funnel Beta

File sharing enabled ×

Robert switched on the Taildrop feature in Tailscale to back up files to his phone.

> "So I can now back up files securely to my newly created portable vault simply by right-clicking them in File Explorer"

Next, I needed to install the Tailscale app on my old Android phone. This initially posed a problem because my Moto G50 no longer had a SIM card to get it online, but connecting to my Wi-Fi network provided the obvious solution.

I downloaded the app from the Google Play Store (**tinyurl.com/APC541tail**), tapped Get Started and gave it permission to set up a VPN connection. I then logged into my Tailscale account, and successfully connected the phone to my tailnet. This now listed both my PC and phone (see screenshot left), so everything was clearly working as intended – fairly unusual for this column, as regular readers will be all too aware.

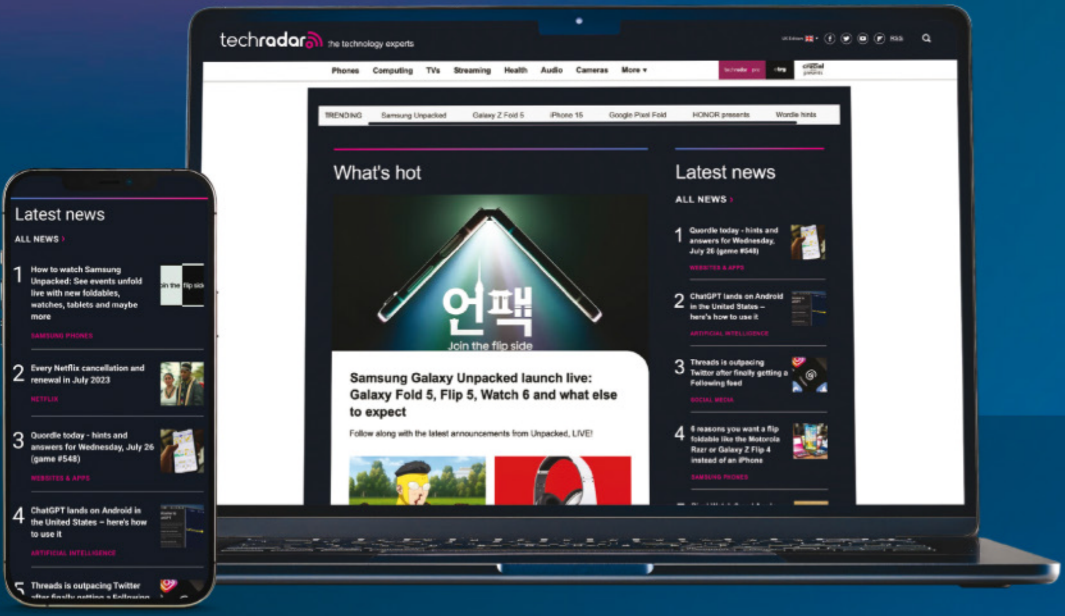
It was now time to try transferring some files. On my computer, I right-clicked the Tailscale icon in the system tray, selected 'Admin console' and clicked the Settings tab. In the 'Feature previews' section, I switched on the Send Files setting (1 in our screenshot above) to activate Taildrop. The feature is apparently still in alpha, which felt quite reckless and exciting.

With file-sharing enabled 2, I could send the first item to my phone. I right-clicked a file in File Explorer, chose the new 'Send with Tailscale' option and selected my Moto G50 in the window that opened.

This seemed to transfer the file, but my phone gave no indication that it had received it. I tried again with a different file, but again no notification. A quick glance at the Taildrop how-to guide suggested looking in the Downloads folder on my Android device, and – lo and behold – there sat the two files from my PC.

So I'm now able to back up files securely to my newly created portable vault simply by right-clicking them in File Explorer. Nobody can access them, unless they steal my finger to unlock my phone, and even then they won't know to check in the Downloads folder. It's nice to have a Tail with a happy ending. ■

Meet the technology experts



techradar the technology experts

Phones Computing TVs Streaming Health Audio Cameras More ▾

TRENDING Samsung Unpacked Galaxy Z Fold 5 iPhone 15 Google Pixel Fold HONOR presents Wordle hints

What's hot

언팩

Join the flip side

Samsung Galaxy Unpacked launch live: Galaxy Fold 5, Flip 5, Watch 6 and what else to expect

Follow along with the latest announcements from Unpacked, LIVE!

Latest news

ALL NEWS ›

1 Quordle today - hints and answers for Wednesday, July 26 (game #548)
WEBSITES & APPS

2 ChatGPT lands on Android in the United States – here's how to use it
ARTIFICIAL INTELLIGENCE

3 Threads is outpacing Twitter after finally getting a Following feed
SOCIAL MEDIA

4 6 reasons you want a flip foldable like the Motorola Razr or Galaxy Z Flip 4 instead of an iPhone
SAMSUNG PHONES

Latest news

ALL NEWS ›

1 How to watch Samsung Unpacked: See events unfold live with new foldables, watches, tablets and maybe more
SAMSUNG PHONES

2 Every Netflix cancellation and renewal in July 2023
NETFLIX

3 Quordle today - hints and answers for Wednesday, July 26 (game #548)
WEBSITES & APPS

4 ChatGPT lands on Android in the United States – here's how to use it
ARTIFICIAL INTELLIGENCE

5 Threads is outpacing Twitter

- The world's **most** comprehensive technology website
- An **unrivalled** mix of news, opinions, reviews and features
- **All-new design**, new homepage, new features and special reports
- Backed by **over 300 years** of editorial experience

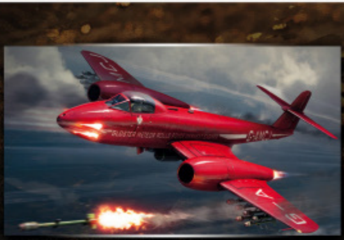
techradar
the technology experts

www.techradar.com

WAR
THUNDER
New?
GET YOUR
FREE
BONUS

WARTHUNDER.COM/TANK

Battle in more than 2500 different aircraft, tanks and ships from the 1930s to present day- Including more than 20 different models of the Legendary Supermarine Spitfire! Control any vehicle using your mouse and keyboard, gamepad or joystick. Now available for FREE on PC, Playstation 5 and Xbox Series. Get your free bonus now!



Windows STEAM Mac oculus VIVE
PS4 XBOX ONE PS5 XBOX SERIES X|S

Gaijin Entertainment
© 2009—2018 by Gaijin Entertainment. All rights reserved.

12
www.pegi.info